



Amy G. Rabinowitz  
*Assistant General Counsel*

September 22, 2005

Mary L. Cottrell, Secretary  
Department of Telecommunications and Energy  
One South Station  
Boston, MA 02110

**Re: D.T.E. 04-116**

Dear Secretary Cottrell:

On behalf of Massachusetts Electric Company and Nantucket Electric Company, I am enclosing our responses to the Department's Record Requests in this proceeding.

Thank you very much for your time and attention to this matter.

Very truly yours,

Amy G. Rabinowitz

Record Request DTE-3

Request:

Each company is requested to provide an analysis that compares the reliability penalties and offsets under the current service quality plan with the proposed IEEE method.

Response:

**The Current Plan**

The current service quality ("SQ") plan allows the following assumptions and criteria to be used in reporting customer interruption results for standardization of reliability metrics:

- A. Customer Equipment Outages will be **excluded** from the calculation of SAIDI, SAIFI, and CAIDI;
- B. Planned outages will be **excluded** from the calculation of SAIDI, SAIFI, and CAIDI;
- C. Excludable Major Events will be **excluded** from the calculation of SAIDI, SAIFI, and CAIDI;
- D. Momentary Outages will be **excluded** from the calculation of SAIDI, SAIFI, and CAIDI;
- E. The beginning of an outage will be recorded at the earlier of an automatic alarm or the first report of no power;
- F. The end of an outage will be recorded at that point that power to customers is restored;
- G. Outages involving a primary distribution circuit will be included in the calculation of SAIDI, SAIFI, and CAIDI. Outages that do not involve a primary distribution circuit (i.e., secondary, line transformers only or services only) will be **excluded** from the calculation of those indices.
- H. Where only part of a circuit experiences an outage, the number of customers affected will be estimated, unless an actual count is available. When power is partially restored, the number of customers restored also will be estimated.

- I. When customers lose power as a result of the process of restoring power (such as from switching operations and fault isolation), the duration of these additional outages will be included, but the additional number of customer interruptions will not be included in the calculation.

Where "Excludable Major Event" is defined as:

*"Excludable Major Event" will mean a major outage event that meets one of the following criteria: (i) the event is caused by earthquake, fire, or storm of sufficient intensity to give rise to a state of emergency being proclaimed by the Governor (as provided under the Massachusetts Civil Defense Act); (ii) any other event that causes an unplanned interruption of service to 15 percent or more of the Company's customers in an Operating Area; or (iii) an event that results from the failure or disturbance of a transmission, power supply, or other system that is not owned or operated by the Company. Notwithstanding the foregoing criteria, an extreme temperature condition would not constitute an Excludable Major Event.*

#### **Use of the Current Plan, re: Excludable Major Events**

For Mass. Electric, 15% of the customer base in 2005 is approximately 180,000 customers. The extreme magnitude required of an external event to affect this number of customers within the Mass. Electric system negates any practical use of this criteria, which then distorts the Company's reported results. In 2002, Mass. Electric reported a SAIDI of 183 minutes. Three weather events, none of which reached the Excludable Major Event criteria, accounted for 75 minutes of that total. The first event was a severe windstorm that occurred on September 11 and affected over 106,000 customers and accounted for over 11 minutes of system SAIDI. The second occurred on November 17 and 18 when another severe wind storm hit Massachusetts. During those two days, an accumulated 137,000 customers were without service and the event accounted for over 45 minutes of annual SAIDI. The third was a Nor'easter that occurred on December 25 and 26, accounted for an accumulated 94,000 customers being without service, and accrued over 18 minutes of system SAIDI. Subtracting these three events from the total would have put Mass. Electric's SAIDI performance at 108 minutes in that year. Including these events within the SQ report structure unfairly penalizes Mass. Electric. Rather than designate a statewide metric, such as 15% of the customers affected (see following table), which necessarily treats each Massachusetts utility differently, Mass. Electric proposes that the Department adopt an industry-wide standard that fairly designates major event days for each utility.

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Company	Customers Served	Threshold for EME	Sq Mi
WMECo	204,000	30,600	1,490
Cambridge	40,000	6,000	1702
Com Elec	325,000	48,750	
Boston Edison	625,000	93,750	
FGE	28,000	4,200	170
MECo	1,250,000	187,500	3,304
Nantucket	11,400	1,710	50

**Proposed New Language**

The IEEE 1366-2003 Guide ("Guide") does not specifically deal with penalties and offsets/incentives. Its intended purpose is explained below:

*"The purpose of this guide is twofold. First, it is to present a set of terms and definitions which can be used to foster uniformity in the development of distribution service reliability indices, to identify factors which affect the indices, and to aid in consistent reporting practices among utilities. Secondly, it is to provide guidance for new personnel in the reliability area and to provide tools for internal as well as external comparisons. In the past, other groups have defined reliability indices for transmission, generation, and distribution but some of the definitions already in use are not specific enough to be wholly adopted for distribution. Users of this guide should recognize that not all utilities would have the data available to calculate all the indices."*

Within the Guide, a methodology is offered that allows the determination of Major Event Days ("MEDs"). Mass. Electric suggests that the Department use this methodology in lieu of the existing "Excludable Major Events" language. Mass. Electric proposes that the Department amend the existing language to:

For the purpose of calculating SAIDI, SAIFI, and CAIDI, the following assumptions and criteria are to be used in reporting customer interruption results for standardization of reliability metrics:

- A. Customer Equipment Outages will be excluded from the calculation of SAIDI, SAIFI, and CAIDI;
- B. Planned outages will be excluded from the calculation of SAIDI, SAIFI, and CAIDI;
- C. Major Event Days will be excluded from the calculation of SAIDI, SAIFI, and CAIDI;

- D. Momentary Outages will be excluded from the calculation of SAIDI, SAIFI, and CAIDI;
- E. The beginning of an outage will be recorded at the earlier of an automatic alarm or the first report of no power;
- F. The end of an outage will be recorded as that point when power to all customers is restored;
- ~~G. Outages involving a primary distribution circuit will be included in the calculation of SAIDI, SAIFI, and CAIDI. Outages that do not involve a primary distribution circuit (i.e., secondary, line transformer only or service only) will not be included in the standardized indices.~~
- H. Where only part of a circuit experiences an outage, the number of customers affected will be estimated, unless an actual count is available. When power is partially restored, the number of customers restored also will be estimated.
- I. When customers originally affected by an outage subsequently lose power as a result of the process of restoring power to the remaining customers originally affected by the outage (such as from switching operations and fault isolation), the duration of these additional customer interruptions will be included, but the additional number of customer interruptions will not be included in the calculation.

Strike "Excludable Major Event" and instead add the terms Major Event and Major Event Day as defined by the current version of IEEE 1366. That is:

Major Event

Designates an event that exceeds reasonable design and or operational limits of the electric power system. A Major Event includes at least one Major Event Day.

Major Event Day

A day in which the daily system SAIDI exceeds a threshold value,  $T_{MED}$ . For the purposes of calculating daily system SAIDI, any interruption that spans multiple calendar days is accrued to the day on which the interruption began. Statistically, days having a daily system SAIDI greater than  $T_{MED}$  are days on which the energy delivery system experienced stresses beyond that normally expected (such as severe weather). Activities that occur on major event days should be separately analyzed and reported.

$T_{MED}$  should be calculated as described in the current version of IEEE 1366.

### **Why the Benchmark/Targets are Required to be Changed**

If the Department does change its methodology, new penalty-offset/incentive bands must be developed that are keyed to past performance as determined by this new and different approach. Mass. Electric further suggests that the Department accept the log-normal characteristic of reliability data, identified and utilized within IEEE 1366-2003, and apply the methods required of such data to the creation of the penalty-offset/incentive benchmarks.

During the development of IEEE 1366-2003, the Working Group on System Design realized that reliability data is not distributed on a normal or Gaussian basis. A Gaussian, or normal distribution, is best represented by a "bell-shaped" curve. When average and standard deviation methods are used to define equal probability of occurrence around the central value of the data population, they must be applied to normal, or Gaussian distributed data; i.e., data distributed as a "bell-shaped" curve. Until this work was undertaken, most people were unaware that reliability performance data was not normally distributed. The distribution of the log values of the reliability data closely resembles a bell-shaped curve, allowing the appropriate application of the average and standard deviation to determine penalty-offset/incentive benchmarks with equal probabilities of occurrence.

### **Mass. Electric Performance Under the Current SQ Plan**

The figure shown below outlines Mass. Electric's performance from 1997 through 2004. The penalty/incentive bands are shown based on 2004 performance. Notice that the penalty bands are very narrow yet the incentive bands are very wide. This phenomenon is occurring because the design of the current SQ plan does not account for the non-Gaussian distribution of the data, and the inability to adjust the penalty bands as more years of data are accumulated with greater variability of the results occurring.

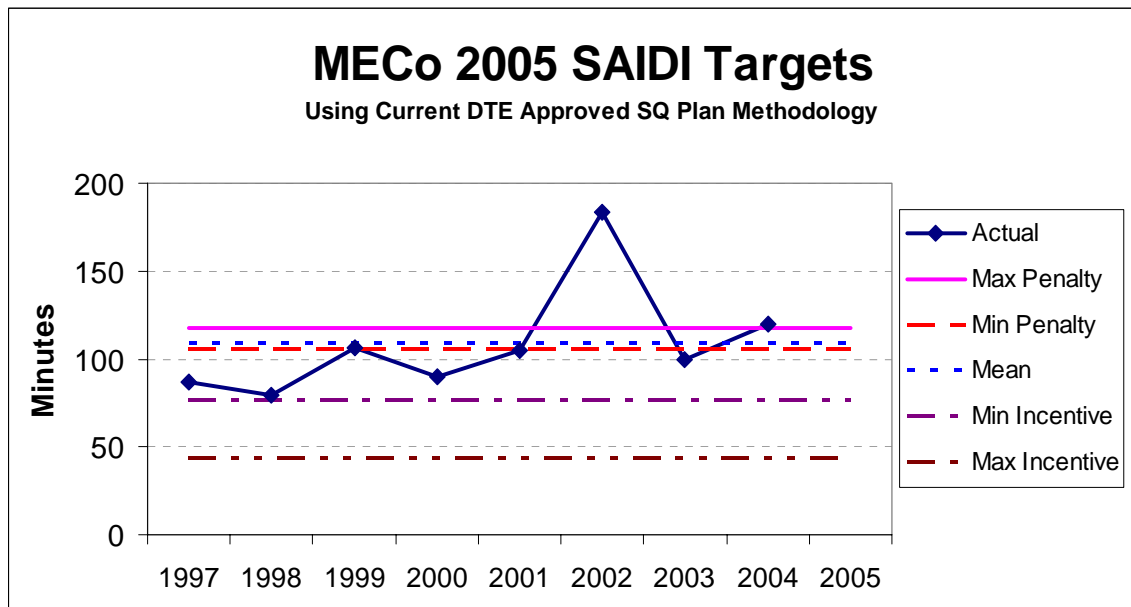


Figure 1. MECo Performance Using Current SQ Plan

The tables below show the data for the chart above.

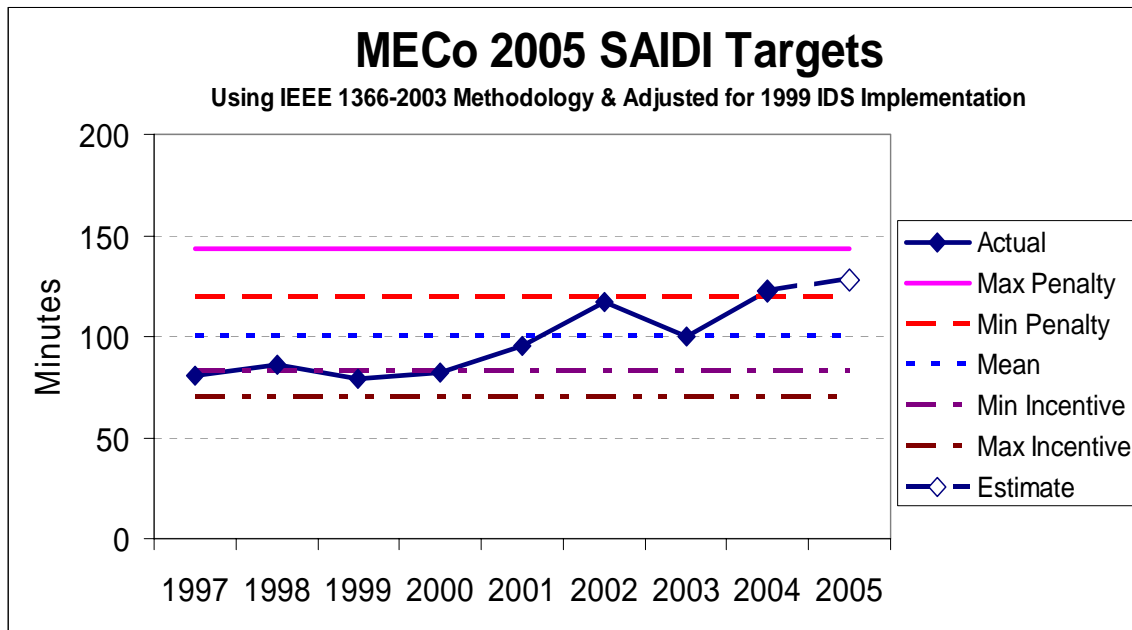
Year	DTE Performance
1997	87.05
1998	79.54
1999	106.62
2000	90.25
2001	105.19
2002	183.36
2003	99.36
2004	119.48

Max Pen	Min Pen	Mean	Min Inc	Max Inc
117.300	105.520	108.860	76.230	43.600

The current SQ plan targets are developed based on the average and standard deviation of past performance over a limited number of years. Because performance is not Gaussian, using the average and standard deviation unfairly biases the target bands. Utilizing a limited number of years to identify past performance can produce a distorted picture of the normally expected variability of the reliability metrics.

### The Proposed Changes

As was originally proposed in DTE 99-84, the Company supports a ten-year rolling period for penalty-offset/incentive determination, starting with 1997 and ending with 2006. For the initial calculation, it is proposed that the years 1997 through 2005 are used and that those targets be developed using a log-normal based process. The data would be reported as proposed, with Major Event Days determined by the methods presented in IEEE 1366-2003. For Mass. Electric, the following graph shows the target bands and past years' performance.



**Figure 2. MECo Performance using IEEE**

The following tables show the data used to create the chart above.

Year	IEEE Performance
1997	80.84
1998	86.41
1999	79.13
2000	82.3
2001	95.73
2002	117.01
2003	100.07
2004	122.24
2005	133

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Max Pen	Min Pen	Mean	Min Inc	Max Inc
143.048	119.554	99.918	83.057	69.792

Prepared by or under the supervision of: Cheryl A. Warren

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Record Request DTE-4

Request:

Each company is requested to provide an analysis of the impact on reliability measures of changing the definition of momentary outages from outages of less than one minute to outages of less than five minutes.

Response:

For Mass. Electric, the percent of SAIDI and SAIFI for events that had a duration between 1 and 5 minutes for each of the past five years is presented in the following table.

	2000	2001	2002	2003	2004
% of SAIDI between 1 and 5 minutes	0.15%	0.08%	0.04%	0.07%	0.09%
% of SAIFI between 1 and 5 minutes	3.1%	1.9%	1.01%	1.9%	2.0%

Prepared by or under the supervision of: Cheryl A. Warren

Record Request DTE-5

Request:

Each company is requested to provide an analysis that compares the current excludable major event criteria of “any other event that causes an unplanned interruption of service to 15 percent or more of the company’s customers in an operating area” to the IEEE major event day.

Response:

Since the results of using the IEEE 1366-2003 Major Event Day method requires a re-determination of the penalty-offset/incentive benchmarks, a simple one-to-one comparison cannot be done. One cannot simply substitute the IEEE 1366-2003 method of identifying Major Event Days for the present Department criteria for determining Excludable Major Events and apply the reliability metrics to the present benchmarks. While the results may be close enough for some companies such that it would appear to be appropriate to do so, the simple substitution would eventually distort the efficacy of the process.

The actual comparison of the two approaches, including the recalculation of the penalty-offset/incentive benchmarks, is included in the response to Record Request DTE-3.

The following table shows the days selected by the IEEE 1366-2003 Major Event Day approach, as well as the days excluded using the 15% criteria of the current service quality plan.

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Date	Year	EVENTS	CI	CMI	SAIDI	Threshold (Tmed)	EME (15% only )
12/17/2000	2000	424	73,536	9,238,778	7.74	3.5	
04/08/2000	2000	191	41,134	4,727,857	3.96		
08/10/2000	2000	133	32,794	6,189,989	5.19		
03/06/2001	2001	472	174,876	50,796,118	42.19	3.48	3/5 and 3/6
06/30/2001	2001	666	139,498	52,201,020	43.36		
07/01/2001	2001	569	58,637	13,606,110	11.30		
03/30/2001	2001	96	42,744	6,694,456	5.56		
08/03/2001	2001	204	36,404	7,976,333	6.62		
08/07/2001	2001	97	27,300	5,441,365	4.52		
07/03/2001	2001	23	26,384	7,264,890	6.03		
09/11/2002	2002	392	106,356	14,194,570	11.68	3.62	
11/17/2002	2002	391	93,505	42,540,138	35.00		
12/25/2002	2002	283	72,814	18,363,126	15.11		
05/03/2002	2002	287	60,942	5,068,303	4.17		
07/23/2002	2002	275	55,460	5,798,364	4.77		
11/18/2002	2002	353	43,962	12,744,467	10.49		
07/09/2002	2002	47	13,975	6,962,457	5.73		
10/15/2003	2003	688	184,620	37,595,644	30.59	4.2	10/15-10/16
12/06/2003	2003	118	81,675	10,035,976	8.17		
12/07/2003	2003	129	32,293	6,464,610	5.26		
11/05/2004	2004	345	78,588	11,270,297	9.08	4.49	
07/02/2004	2004	324	42,686	6,692,979	5.39		
11/28/2004	2004	75	41,958	10,598,970	8.53		

Prepared by or under the supervision of: Cheryl A. Warren

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Record Request DTE-6

Request:

Each company is requested to submit their inspection and maintenance guidelines or procedures.

Response:

Please find attached to this response the Company's Electric Operating Procedures.

Prepared by or under the supervision of: Edward J. Dienst

<b>nationalgrid</b>  <b>ELECTRIC OPERATING PROCEDURES</b>	<b>Doc No.:</b> NG-USA EOP G016
	<b>Page:</b> Page 1 of 10
	<b>Date:</b> 07/25/05
<b>SUBJECT:</b> Elevated Equipment Voltage Testing	<b>SECTION:</b> General

**REFERENCE:**

NYPSC Order 04-M-0159  
Applicable National Grid Safety Rules & Procedures  
Testing Equipment Operation Instructions

**GENERAL INFORMATION:**

The purpose of this procedure is to outline the requirements for the annual elevated equipment voltage testing on National Grid Facilities in New York as required by the New York Public Service Commission's "Electric Safety Standards" issued on January 5, 2005.

This procedure also outlines corporate requirements for elevated equipment voltage testing in New England. The variance in requirements between New York and New England is based on sound utility practice versus regulatory requirements.

**PROGRAM ADMINISTRATOR:**

Delivery Engineering Services

**APPLICABILITY**

This procedure applies to all personnel involved with or responsible for the testing of facilities designated by this EOP for elevated equipment voltage.

**SCOPE:**

- I. Facilities Where Elevated Equipment Voltage Testing/Documentation is Required – New York
  - A. Street Lights and Municipally Owned Facilities
  - B. Substation Fences
  - C. Overhead Distribution Facilities
  - D. Overhead Transmission Facilities
  - E. Underground Facilities
  - F. Daily Work Areas
  - G. Exemptions
- II. Facilities Where Elevated Equipment Voltage Testing/Documentation is Required – New England
  - A. Street Lights
  - B. Substation Fences
  - C. Overhead Distribution Facilities
  - D. Underground Facilities
  - E. Daily Work Areas
  - F. Exemptions

Supersedes Document Dated: New Document	Authorized By: Director-Delivery Engrg. Services	Approved By: VP - Engineering Services
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- III. Test Equipment
- IV. Test Procedure
- V. Corrective Action Requirements
- VI. Database Requirements
- VII. Annual Reporting and Certification Requirements
- VIII. Responsibility
- IX. Definitions
- X. Training

## **I. FACILITIES WHERE ELEVATED EQUIPMENT VOLTAGE TESTING/DOCUMENTATION IS REQUIRED – NEW YORK**

### **A. Street Lights and Municipally Owned Facilities**

1. Company owned metallic street lighting standards are required to be tested for elevated equipment voltage annually. This test is to be performed while the light is operating.
2. Municipally owned street light systems that National Grid directly provides energy to must be tested for elevated equipment voltage annually. National Grid will complete this testing unless assurances of the completion of required testing and transfer of such test data are made by the appropriate municipality. This test is to be performed while the light is operating.
3. Municipal owned metallic traffic signal standards and accessible devices are to be tested annually for elevated equipment voltage by National Grid.
4. All street lights identified on public thoroughfares regardless of ownership are to be tested annually.
5. All street lights under a maintenance contract are to be tested annually.
6. Exceptions not requiring elevated equipment voltage testing: private lighting, park associations, parking lots, fiberglass (or other non-conductive) street light standards, and locations where street light standards are not publicly accessible, such as facilities located in the center of highways that cannot be accessed without stopping traffic or creating potentially hazardous situations for the worker and/or public.

### **B. National Grid Substation Fences**

1. Metallic fencing surrounding substations with National Grid Facilities shall be tested for elevated equipment voltage annually. This fencing can be customer owned for customer stations, if a National Grid facility is part of the station.
2. See reference to NG-USA EOP 400.06.2 Substation - V&O Inspection Procedure.

### **C. Overhead Distribution Facilities**

1. Towers and/or metallic poles with distribution facilities shall be tested annually for elevated equipment voltage.
2. The following equipment on wood distribution poles requires annual elevated equipment voltage testing:
  - a. Metallic riser guard or conduit (company or non-company).
  - b. Uncovered or uninsulated down ground (company or non-company).
  - c. Down guy (company or non-company).
  - d. Any other publicly accessible conductive piece of equipment (company or non-company) on the pole within reach from the ground.
3. Exceptions: Customer meters and customer meter poles are excluded.

### **D. Overhead Transmission Facilities**

1. Towers and/or metallic poles with transmission facilities shall be tested annually for elevated equipment voltage.
2. The following equipment on wood transmission poles or structures require annual elevated equipment voltage testing:

- a. Metallic riser guard or conduit (company or non-company).
- b. Uncovered or uninsulated down ground (company or non-company).
- c. Down guy (company or non-company).
- d. Any other publicly accessible conductive piece of equipment (company or non-company) on the pole or structure within reach from the ground.

E. Underground Facilities

1. Annual elevated equipment voltage testing is required on all of the following equipment where accessible to the public.
  - a. All metallic manhole covers, vault covers and grates, junction box covers, handhole covers, pad mount transformers, and switchgear.
2. Exceptions: Non-metallic concrete or fiberglass pads or handholes are not required to be tested.

F. Daily Job Site Test Requirements

1. Each job site where National Grid personnel or its contractors complete a work assignment shall be tested for elevated equipment voltage at the end of the work day or the completion of the assignment. **This testing requirement is considered good utility practice and does not require specific documentation.**
2. Exceptions:
  - a. Substation fencing will not require elevated equipment voltage testing unless scheduled as part of the inspection program or if work was done on the fencing.
  - b. In a storm situation, where mutual aid is required, testing by other than National Grid personnel will not be required.

G. Exemptions

1. A completely fenced in area where access is denied to the general public and where access is only achieved by climbing a fence. Good judgment is required by the tester in these scenarios.

## **II. FACILITIES WHERE ELEVATED EQUIPMENT VOLTAGE TESTING/DOCUMENTATION IS REQUIRED – NEW ENGLAND**

A. Company Owned Street Lights

1. Testing will be performed during each outage investigation notification and the data will be recorded for each instance.

B. National Grid Substation Fences

1. Metallic fencing surrounding substations with National Grid Facilities shall be tested for elevated equipment voltage annually.
2. See reference to NG-USA EOP 400.06.2 Substation – V&O Inspection Procedure.

C. Overhead Distribution Facilities

1. Wood distribution poles require testing to be completed on metallic risers in conjunction with the distribution patrol program covered by NG-USA EOP D004.
2. Documentation is only required on metallic risers found to be at an elevated voltage requiring repair. Testing data is not required for a facility that is found to be operating as designed.

D. Underground Facilities

1. Testing for elevated equipment voltage shall be done while completing scheduled inspections of underground equipment covered by NG-USA EOP UG006, Underground Inspection and Maintenance. The following items are to be tested on a five year cycle, padmount transformers, switchgears, and metallic handhole covers.

2. Testing for elevated equipment voltage shall be completed on underground facilities while completing working inspections covered by NG-USA EOP UG006. The metallic items to be tested are manholes covers, vault covers, handhole covers, splice box covers, junction box covers, padmount transformers, switchgear, and submersible equipment covers.
- E. Daily Job Site Test Requirements
1. Each job site where National Grid personnel or its contractors complete a work assignment shall be tested for elevated equipment voltage at the end of the work day or the completion of the assignment. **This testing requirement is considered good utility practice and does not require specific documentation.**
  2. Exceptions:
    - a. Substation fencing will not require elevated equipment voltage testing unless scheduled as part of the inspection program or if work was done on the fencing.
    - b. In a storm situation, where mutual aid is required, testing by other than National Grid personnel will not be required.
- F. Exemptions
1. A completely fenced in area where access is denied to the general public and where access is only achieved by climbing a fence. Good judgment is required by the tester in these scenarios.

### **III. TEST EQUIPMENT**

- A. A hand held device (proximity detection unit) that is capable of detecting voltage from 8 volts to 600 volts.
- B. A portable AC digital high impedance volt meter must have the ability to take readings with and without an input load impedance of 500 ohms.
- C. The handheld devices utilized must be certified to indicate a minimum of 8 volts and be capable of withstanding a maximum of 1000 volts by an independent laboratory. The portable AC digital voltmeter must be capable of measuring a minimum of 0.1 volt and a maximum of 1000 volts, the following units has been certified:
  1. HD Electric model LV-S-5 (5-600 volts).
  2. Fluke 85
  3. Fluke 87
  4. Fluke 170 series or equivalent
  5. Fluke 175
  6. Fluke 177
  7. Fluke 179
  8. Fluke 187
  9. Fluke 189

### **IV. TEST PROCEDURE**

- A. Job Briefing
1. At minimum, the following information must be communicated to all personnel at the beginning of each shift for elevated equipment voltage testing:
    - a. Structures are never to be touched with a bare hand while performing the tests, only the voltage detector or meter probe is to be used to make contact with the facilities.
    - b. Appropriate PPE must be worn.
    - c. Each individual needs to be aware of his/her surroundings at all times.

- d. Make sure to observe all traffic before entering a street, either at intersections or any other point.
- e. Traffic safety vest (DOT Compliant Class II) is to be worn at all times when exposed to traffic. Be aware that when bending down, the visibility benefits of the traffic safety vest are diminished.
- f. Obey all traffic control devices.
- g. When working in the street, face oncoming traffic whenever possible.

**B. Measurements for voltages will be performed in accordance with the following:**

1. Initial measurements for the presence of voltage shall be made using a certified proximity detection unit as noted in the testing equipment certified equipment list in Section II C.
  - a. To verify the proper operation of the proximity detector, follow operating instructions for the particular certified unit being utilized, this is to be done daily.
  - b. After verification that the detection unit is working, approach the area/equipment to be tested. The proximity detector will illuminate prior to touching the area/equipment being tested if voltage is present. If the proximity detector does not illuminate in close proximity to the area/equipment touch the area/equipment to be tested with the probe of the unit.
2. If this test detects voltage, repeat the test with the portable AC voltmeter:
  - a. Measurements with a portable AC voltmeter shall be taken on clean bare metallic surface (structure, ground wire, etc.)
  - b. When using a portable AC voltmeter, connection shall be made to suitable neutral or ground source with the common (black) lead.
    - i. In locations where the neutral or ground point is at a distance in excess of the voltmeter lead length, the connection to the neutral/ground shall be made with up to 25' of # 16 stranded copper lead wire (covered), the other end of which shall be securely connected to the negative (black) probe of the meter. When using such "extension leads" appropriate care shall be taken in the placement of such leads so as to not create a physical hazard to workers, pedestrian or vehicular traffic.
    - ii. In locations where a system ground is not available, or the existing ground registered voltage upon the proximity test, a metal rod shall be firmly embedded into the earth to a depth of no less than 6" to create a ground reference point for the measurement to be taken. The reference point should be as close as practicable to the facility being tested to simulate an elevated equipment voltage situation (3' to 4'.) On occasion longer leads may be necessary to find undisturbed earth (up to 25'.)
  - c. The "live" meter probe lead shall then be placed into contact with the structure under inspection.
    - i. Install a 500 ohm input load impedance on the volt meter. Measure the voltage and record this voltage in the database for the site.

## **V. CORRECTIVE ACTION REQUIREMENTS**

- A. If an elevated equipment voltage condition is found and verified by the Test Procedure in Section IV, the site is to be guarded until made safe by Company personnel or if municipally owned, made safe by the owner or company. Guarded for the purposes of this EOP is defined as guarded by a person or a protective barrier that prevents public contact if the elevated equipment voltage found is greater than 4.5 volts. **If the voltage measures less than 4.5 volts and is found to be consistent with system operation design (no visual evidence of a problem upon review) no further action is required.** If the voltage measures greater than 4.5 volts and less than 8 volts it can either be guarded in person or by a protective barrier that prevents public contact, contact your supervisor for required action. It is expected that sound judgment shall be utilized in this application. If the voltage measures greater than 8 volts immediate response is required using the notification in section B below.
- B. The following notification process for personnel to respond shall be utilized.
1. Notification by location:
    - a. New York: contact Systems Operations Dispatch 1-877-716-4996
    - b. Bay State West, and Bay State North & Granite: Westboro Control Center 508-389-9032.
    - c. Bay State South, and Ocean State: Lincoln Control Center 401-335-6075.
  2. Inform the operator that this is an elevated equipment voltage call, giving inspector name, company (if not National Grid), unique ID, address where problem is identified, facility number, circuit number, ownership, type of equipment, voltage found and whether they are physically guarding or leaving the site after flagging and installing a protective barrier. National Grid personnel or designee will be assigned to respond.
- C. Temporary repairs may be used to correct the elevated equipment voltage thereby removing the need to guard the site.
- D. Except as noted in V.E, permanent repairs to the equipment shall be made within 45 days of the occurrence.
- E. If permanent repairs can not be made within 45 days due to extraordinary circumstances, the company shall periodically perform site visits to monitor the condition of the temporary repair. For New York, all exceptions must be identified and justified in the annual reporting of the program to the NYPSC.
- F. The Tester/Inspector may detect a minimal voltage level that is attributable to the design of the facility and not the result of an improper condition, no corrective action is required in this instance.
- G. The individuals conducting the elevated equipment voltage tests on street light standards shall have a supply of "Angel guards" available for installation if the cover is missing or wires are found to be exposed to the public at the time of testing. Angel guards shall only be installed after the testing of the street light standard is complete and 1) there is no indication of elevated equipment voltage above 4.5 volts, or 2) repairs have been completed to correct the elevated equipment voltage.
- H. The elevated equipment voltage tester shall report any potentially hazardous conditions found on National Grid facilities seen visually during the survey process.
- I. Customer Owned Equipment
1. Where the Company finds elevated equipment voltage above 4.5 volts and identifies its source as customer-owned equipment, the Company shall guard the site and notify the customer or a responsible person, as appropriate, that a potentially hazardous situation exists. The Company shall advise the customer or responsible person that the cause of the elevated equipment voltage must be immediately remedied.

2. Company personnel are encouraged to work with the customer to determine and rectify the problem. If the customer agrees to accept the Company's assistance, the Company may charge a reasonable cost for this effort.
3. The Company may temporarily remove a customer's meter or take such other actions as are appropriate and necessary to protect the public.

## **VI. DATABASE REQUIREMENTS**

- A. The database in use shall be easily searchable for information and reporting.
- B. Information fields required to be completed for facilities:

1. Survey Date
2. Region
3. District
4. Contractor
5. GIS ID/Asset # (Unique ID)
6. Facility Type
7. Owner
8. Feeder/Circuit
9. Line #
10. Tax District
11. Pole/Structure/Equipment ID
12. Street Name
13. Inspectors Name
14. GPS Taken
15. Pre-load Match
16. Elevated Equipment Voltage Test Required
17. Voltage Found Y/N
18. Voltage Measurement
19. Type of Equipment (See Appendix A)
20. Immediate Action Taken
21. Person Notified
22. Permanent Repair Date
23. Type of Repair
24. Person Responsible for repair (Employee ID)

## **VII. NEW YORK ANNUAL REPORTING AND CERTIFICATION REQUIREMENTS**

- A. Each Regional program supervisor shall provide certification to the program manager that the Region they supervise has complied with the elevated equipment voltage testing and inspection program as ordered by the PSC.
- B. The program manager shall provide certification to the Vice President Distribution Network Strategy and the Senior Vice President of Distribution Network Strategy that the organization has complied with the elevated equipment voltage testing and inspection program as ordered by the PSC.
- C. Written certification of the completion and results of every elevated equipment voltage test and inspection shall be completed, as well as a certification that all unsafe conditions identified have been remediated by appropriate company personnel.

- D. The President or officer with direct responsibility for overseeing the elevated equipment voltage testing and inspection shall provide an annual certification to the NYPSC that the Company has tested all of its publicly accessible conductive surface electric facilities and all street lights, as well as completed all required inspections.
- E. The annual reporting and certification is required by January 15 of each year. In addition to certifications, it shall address the following:
  - 1. Analyses of elevated equipment voltage data to show trends or common causes.
  - 2. Discussion of performance mechanism, if required.
  - 3. Changes to program implementation due to lessons learned.
- F. The Company shall maintain its written certification and other documentary proof of its testing at its' Albany, Buffalo, and Syracuse office facilities. These documents shall be made available to the public for review upon request.

## **VIII. RESPONSIBILITY**

- A. Delivery Engineering Services
  - 1. Update program as necessary.
  - 2. Provide field support and training upon request.
  - 3. Act as liaison with existing database vendor when required.
- B. Field Operations
  - 1. Ensure the elevated equipment voltage program as outlined in this EOP is implemented properly and timely.
  - 2. Ensure that the program as outlined in the EOP is completed each year.
  - 3. Provide qualified personnel to complete elevated equipment voltage testing.
  - 4. Ensure all elevated equipment voltage testers have been trained.
- C. C&MS Management
  - 1. When requested by Field Operations/Distribution Network Strategy obtain, schedule and manage contractors to perform elevated equipment voltage testing.
  - 2. Ensure all elevated equipment voltage testers have been trained.
  - 3. Manage contractual terms and conditions including all change orders and resource requirements.
  - 4. Establish a process for the delivery of work, collection of data, invoice verification and payment, and reporting to local management and Distribution Network Strategy.
  - 5. Manage any established support processes such as back office support or data entry clerks.
- D. Elevated Equipment Voltage Inspector
  - 1. Demonstrate the ability and proficiency to perform elevated equipment voltage testing per this EOP.
  - 2. Demonstrate the ability to become proficient in the use of the appropriate database.
  - 3. Possess the ability to do walking patrols, collect information, edit data, and guard unsafe facilities.
  - 4. Attend elevated equipment voltage training program.
- E. T&D Technical Training
  - 1. Provide training upon request.
- F. Distribution Network Strategy

1. Provide input into program revisions.
2. Ensure the elevated equipment voltage program as outlined in this EOP is implemented properly and timely.
3. Ensure the program as outlined in the EOP is completed each year.
4. Provide qualified personnel to complete elevated equipment voltage testing.
5. Ensure all elevated equipment voltage testers have been trained.
6. Provide program management.

G. Process and Systems

1. Provide and support database.

**IX. DEFINITIONS:**

- A. “Stray Voltage” – As defined by NYPSC the term “Stray Voltage” means voltage conditions on electric facilities that should not ordinarily exist.
- B. Proximity Detection Unit – A low voltage hand held detector used to test exposed metallic surfaces and conductors for the presence of low voltage from 8V to 600V.
- C. Elevated Equipment Voltage Inspector – The individual performing the elevated equipment voltage inspection.
- D. Handheld Computer - An electronic Data recording device that is used in the field to create a record of conditions found.
- E. Elevated Equipment Voltage – An A.C. rms voltage difference between utility equipment and the earth, or to nearby grounded facilities that exceeds the lowest perceptible voltage levels for humans.

**X. TRAINING:**

- A. Delivery Engineering Services with assistance from the database vendor will provide training on the utilization of handheld computers and the selected database.
- B. At a minimum, each worker conducting these tests should have knowledge and training in the following areas:
1. Proper use of appropriate Personal Protective Equipment.
  2. Work Area Protection.
  3. Hazard Communication.
  4. First Aid CPR (This is required only on multi-person crews.)
  5. The proper use of certified voltage detection units and voltmeters.
  6. Hazardous condition identification.

The attendance of this training shall be documented.

**TYPE OF EQUIPMENT  
APPENDIX A**


TYPE	CODE	EQUIPMENT DESCRIPTION
Distribution	910	Pole
	911	Regulator
	912	Sectionalizer
	913	Recloser
	914	Ground
	915	Guy
	916	Riser
	917	Switch Handle Mechanical Operated
	929	Distribution – Other (use comments)
Transmission	930	Pole
	931	Tower
	932	Guy
	933	Ground
	934	Riser
	935	Switch Hand Mechanical Operator
	949	Transmission – Other (use comments)
Underground	950	Handhole
	951	Manhole
	952	Switchgear
	953	Transformer
	954	Vault – Cover/Door
	969	Underground – Other (use comments)
Street Light	970	Handhole
	971	Standard
	979	Street light – Other (use comments)
Customer Street Light/Other		
	980	Handhole
	981	Standard
Traffic Control	989	Customer SL/Other – Other (use comments)
	990	Handhole
	991	Standard
	992	Control Box
	993	Pedestrian Crossing Pole
	999	Traffic control – Other (use comments)

**NG-USA EOP G016**

**“Elevated Equipment Voltage Testing”**

**07/25/05**

This is a new procedure.

 <b>ELECTRIC OPERATING PROCEDURES</b>	<b>Doc No.:</b> NG-USA EOP G017
	<b>Page:</b> Page 1 of 6
	<b>Date:</b> 07/25/05
<b>SUBJECT:</b> Street Light Standard Inspection Program	<b>SECTION:</b> General

#### REFERENCE:

Applicable National Grid Safety Rules and Procedures  
NY PSC Order 04-M-0159  
Elevated Equipment Voltage NG-USA EOP G016

#### GENERAL INFORMATION:

The purpose of this procedure is to outline the requirements for the inspection cycle for Street Light Standard installations owned by National Grid in New York as required by the New York Public Service Commission's "Electric Safety Standards" issued on January 5, 2005. **This procedure specifies the inspection interval and requirements for New York only.**

The inspection shall include identifying and reporting the physical condition of street lighting equipment on street lighting standards. Street lights attached to wood poles are inspected as part of the Overhead Distribution Inspection Patrol covered by NG-USA EOP D004.

All street lighting equipment will be inspected for physical damage, potentially hazardous conditions or obvious deterioration.

Inspections will be recorded on a hand held computer. The maintenance items identified during this inspection will be separated into four priority categories A, B, C, and E priority. The problem codes identified default to the appropriate priority. The default priority can be adjusted by the individual performing the inspection based on actual field conditions.

These priority categories are defined as follows:

*A Priority* - An identified facility/component that must be repaired/replaced as soon as practicable.

*B Priority* – An identified facility/component condition that shall be considered for repair/replacement as the facilities are scheduled for maintenance by Distribution Planning and Engineering. These identified conditions will be corrected as preventive maintenance and or facility life extension.

*C Priority* – An identified facility/component condition that is being trended and reviewed by Distribution Planning and Engineering that may require replacement through the engineering process (Requires project/Capital expenditures). Non-capital conditions identified under this priority will be corrected at the discretion of field operations.

Supersedes Document Dated: New Document	Authorized By: Director-Delivery Engrg. Services	Approved By: VP - Engineering Services
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*E Priority* – An identified facility/component that must be replaced/repared immediately to address public safety or system reliability. The inspector shall notify the appropriate operations department for immediate response and corrective action any time an E priority is found during an inspection.

*ALL “A PRIORITY” CONDITIONS IDENTIFIED PRIOR TO NOVEMEBR 1<sup>ST</sup> MUST BE REPAIRED/CORRECTED BY NOVEMBER 30TH.*

*ALL “E PRIORITY” CONDITIONS SHALL BE CORRECTED IMMEDIATELY UPON NOTIFICATION.*

Equipment will be inspected on a five year cycle such that one-fifth of the inspections should be scheduled on an established annual basis.

**PROGRAM ADMINISTRATOR:**

Delivery Engineering Services

**APPLICABILITY**

This procedure applies to all personnel involved with or responsible for the inspection and maintenance of street lighting standards and associated facilities owned by National Grid in New York.

**SCOPE:**

- I. Patrols
- II. Equipment to be Inspected and Maintenance Codes
- III. Maintenance Data Base/Reports
- IV. Maintenance
- V. Work Management
- VI. Completion
- VII. Definitions
- VIII. Responsibilities
- IX. Training

**I. PATROLS:**

Street Lighting inspections will be performed as patrols and are conducted by a street light qualified worker. The patrols are scheduled in such a manner that street lighting facilities are inspected once every five years. Street Light Asset Management is responsible for creating this schedule for their respective areas. The Distribution Inspector uses a hand held computer to record employee ID, region, district, street lighting installation standard number, GPS location, Priority A, B, C and E maintenance items, and comments. The listing of these maintenance items are shown in Table I. Any new facilities added to the system will be incorporated through our Street Light Inventory Data (OLDS) and added to the appropriate inspection cycle. The street light standards inspections scheduled for the year shall be completed by November 30<sup>th</sup>. The inspector shall place the street light standard number on the facility if not found numbered during the patrol.

**II. EQUIPMENT TO BE INSPECTED AND MAINTENANCE CODES:**

- Luminaires
- Arms
- Standards
- Foundations
- Conductor

TABLE I

## PRIORITY A, B and C MAINTENANCE ITEMS FOR OUTDOOR LIGHTING

Category	CODE	Default Priority	Description
Luminaire	300	B	Light "ON" Day
	301	B	Replace Lens
	302	C	Clean
	303	C	Paint
	304	C	Replace Wattage Label
	305	A	Wires Exposed
	306	B	Damaged - Replace
	307	I	Missing
	308	C	Other - Comments
Arm	320	B	Damaged - Replace
	321	C	Damaged - Repair
	322	C	Rust - Paint
	323	C	Other - Comments
Standard	330	B	Struct Damage - Replace
	331	C	Damaged/Leaning - Repair
	332	C	Paint/Maintenance
	333	A	Access Cover - Replace
	334	B	Bad Wiring - Repair
	335	C	Stencil Required
	336	B	Temporary Overhead
	337	A	Ground - Repair
	338	I	Knockdown/Missing
	339	C	Other - Comments
Foundation	350	B	Damaged/Leaning - Repair
	351	B	Anchor Bolts Damaged
	352	B	Elevated - Repair
	353	C	Other - Comments

**Note:** The default priority of "I" for missing luminaries and street light standards is utilized for informational use only. If the standard is missing or missing a street light head, the item shall be reviewed with records, if found to be a required and an active asset it shall be changed to an A priority

### III. MAINTENANCE DATA BASE/REPORTS

The maintenance data base consists of records downloaded from the hand held computers and information entered from the desktop computers. The records can be downloaded to the database through any desktop computer that is connected to the network and the inspector is logged on as a valid user of the Street Light Standard Inspection program. The desktop computer is also used to generate various reports and work tickets, depending on the user's need. These reports/work tickets are utilized to schedule and accomplish distribution maintenance work.

#### **IV. MAINTENANCE**

The maintenance activities are scheduled by priority categories, with the exception of “E Priority” which requires immediate repair. All “A Priority” conditions identified prior to November 1 repaired/corrected by November 30th. The “B Priority” conditions are scheduled based on the reliability of the circuit, and age of facilities. The “B Priority” maintenance is to be performed as selected by Distribution Planning and Engineering and identified in the “Energy Delivery Work Plan”. All “B Priority” maintenance as outlined in the “Energy Delivery Work Plan” must be completed by November 30 of that year. The “C Priority” maintenance work will be completed as planned and directed by the Distribution Planning and Engineering department and Street Light Asset Management (Capital expenditures) after reviewing annually for trends that would require expenditures. Any “C Priority” work that is not capital expense will be completed at the discretion of the T&D operating department.

#### **V. WORK MANAGEMENT**

The time recording of both patrol and maintenance activities is accomplished in the Severn Trent Operating Resource Management System (STORMS).

STORMS requires that the Distribution Inspector/Operations Personnel fill out a daily time sheet. The Distribution Inspector would record their time actually performing the foot patrol inspection of the Distribution system under the DO4025 Activity along with the appropriate work order or a work request if the patrol has been scheduled. Work orders or work request numbers can be obtained from the Operations Supervisor or from the Distribution Planning/Area Resource Coordinator (ARC).

Operations Personnel performing scheduled maintenance on the Distribution System should record their time actually performing maintenance activities under the appropriate work request number set up by their Distribution Planning/ARC in their respective area. Operations Personnel performing maintenance activities that have been not been scheduled should charge the DM4025 activity along with appropriate work order number. STORMS work request numbers are created when the work has been scheduled by Distribution Planning/ARC. Work orders or work request numbers can be obtained from the Operations Supervisor or from the Distribution Planning/ARC.

#### **VI. COMPLETION**

The repair/correction of an identified maintenance item must be reported in the database. This reporting can be done through the edit screen found on the desktop computer. Field personnel that perform the repair/correction are required to complete the work order form providing the date completed, and employee ID number. The work order form is returned to the T&D Supervisor who will report the completed maintenance items in the database at their desktop computer, or designate the distribution inspector or a clerk to perform the reporting. Additional maintenance items, not in the database, that may be discovered and completed by personnel must be noted on the work order ticket so they can be recorded as work completed on that specific facility.

*ALL MAINTENANCE WORK PERFORMED THAT WAS IDENTIFIED ON THE WORK ORDER OR DISCOVERED DURING THE REPAIR/CORRECTION OF THE ORIGINAL MAINTENANCE ITEM MUST BE LISTED IN THE DATABASE AND THEN REPORTED WHEN COMPLETE.*

**VIII. DEFINITIONS**

Patrol – A walking assessment of distribution facilities for the purpose of determining the condition of the facility and it's associated components.

Hand Held Computer – A portable, self-contained electronic data recording device used to create a record of conditions found in the field.

Distribution Inspector – A street light qualified employee who can identify deficiencies, or non-standard construction conditions, on the Company's distribution facilities.

Valid User – An individual who has been authorized to use the Street Lighting Maintenance Program by the Program Administrator.

Street Light Standard – A metallic or fiberglass pole which supports street lighting luminaire(s) and associated wiring.

**IX. RESPONSIBILITIES****Delivery Engineering Services**

1. Update program as necessary
2. Provide field support and training as requested.
3. Report System Maintenance progress monthly by Region.

**Field Operations**

1. Provide qualified personnel as the distribution inspectors, to provide consistent and accurate data or to contact C&MS for contracting where applicable.

**Distribution Inspector**

1. Demonstrate the ability to identify maintenance items and the aptitude to become proficient in the use of a hand held computer and desktop computer.
2. Demonstrate the understanding and requirements of this National Grid EOP.
3. Possess the ability to do patrols, collect information on a hand held, down load to a desktop computer, edit data, provide requested information/reports/work tickets to supervision, and track/close out work completed in the database.

**C&MS**

1. At the request of Field Operations/Distribution Network Strategy obtain, schedule and manage contractors to perform inspections and perform required maintenance.

**Street Light Asset Management**

1. To develop a five-year inspection schedule of all facilities covered by this EOP.

**Distribution Network Strategy**

1. Provide input into program revisions.
2. Ensure the program as outlined in this EOP is completed each year.
3. Provide qualified personnel to inspect where applicable.
4. Ensure all inspectors have been trained.
5. Provide program management.

Process and Systems

1. Provide and support database.

T&D Technical Training

1. Provide training upon request.

**VII. TRAINING**

1. Delivery Engineering Services with assistance from the database vendor will provide training on the utilization of handheld computers and the selected database.
2. Delivery Engineering Services along with the training department will provide training for the identification of A, B, C and E maintenance items to the qualified worker who will be performing the inspections.

**NG-USA EOP G017**

**“Street Light Standard Inspection Program”**

**07/25/05**

This is a new procedure.

<b>nationalgrid</b>  <b>ELECTRIC OPERATING PROCEDURES</b>	<b>Doc No.:</b> NG-USA EOP D004
	<b>Page:</b> 1 of 8
	<b>Date:</b> 07/25/05
<b>SUBJECT:</b> Distribution Line Patrol and Maintenance	<b>SECTION:</b> Transmission & Distribution

**REFERENCE:**

Applicable National Grid Safety Rules and Procedures  
NY PSC Order 04-M-0159  
Elevated Equipment Voltage Testing NG USA EOP-G016  
Underground Inspection NG USA EOP-UG006

**GENERAL INFORMATION:**

The purpose of this procedure is to outline the requirements for the patrol and maintenance activities associated with National Grid Distribution circuits. The Distribution Maintenance Program was designed to provide for a patrol and subsequent maintenance of each distribution circuit once every five years. The patrols are conducted by a Distribution Inspector identifying all required maintenance on a hand held computer. The maintenance items identified through this patrol are separated into five priority categories A, B, C, E and F priority. The problem codes identified default to the appropriate priority. The default priority can be adjusted by the individual performing the inspection based on actual field conditions. These priority categories are defined as follows:

*A Priority* - An identified facility/component or tree condition that must be repaired/replaced as soon as practicable.

*B Priority* – An identified facility/component condition that shall be considered for repair/replacement as the feeder is scheduled for maintenance by Distribution Planning and Engineering. These identified conditions will be corrected as preventive maintenance and or facility life extension.

*C Priority* – An identified facility/component condition that is being trended and reviewed by Distribution Planning and Engineering that may require replacement through the engineering process (Requires project/Capital expenditures). Non-capital conditions identified under this priority will be corrected at the discretion of field operations.

*E Priority* – An identified facility/component that must be replaced/repared immediately to address public safety or system reliability. The inspector shall notify the appropriate operations department for immediate response and corrective action any time an E priority is found during an inspection.

*F Priority* – An identified forestry condition that should be scheduled as time permits, within the routine right-of-way maintenance and danger tree removal schedules.

Supersedes Document Dated: 02/01/02 – EOP 211A	Authorized By: Director-Delivery Engrg. Services	Approved By: VP – Engineering Services
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*ALL "A PRIORITY" CONDITIONS IDENTIFIED PRIOR TO NOVEMBER 1<sup>ST</sup> MUST BE REPAIRED/CORRECTED BY NOVEMBER 30TH.*

*ALL "E PRIORITY" CONDITIONS SHALL BE CORRECTED IMMEDIATELY UPON NOTIFICATION.*

*ALL "F PRIORITY" CONDITIONS IDENTIFIED DURING THE PATROL ARE TRANSMITTED TO THE SYSTEM FORESTRY GROUP ON AN ANNUAL BASIS FOR INCLUSION IN THE RIGHT-OF-WAY MAINTENANCE PROGRAM.*

**PROGRAM ADMINISTRATOR:**

Delivery Engineering Services

**APPLICABILITY**

This procedure applies to all personnel involved with or responsible for the inspection and repair of OH Distribution facilities. Additionally all URD's and UCD's will be scheduled for inspection on the circuit schedule for this OH Distribution Line Patrol and Maintenance EOP. Refer to Underground Inspection and Maintenance NG USA EOP-UG006 for further information on the underground program.

**SCOPE:**

## Distribution Maintenance

- I. Patrol (Hand Held Computer)
- II. Equipment To Be Inspected and Maintenance Codes
- III. Maintenance Data Base
- IV. Maintenance
- V. Work Management
- VI. Completion
- VII. Definitions
- VIII. Responsibilities
- IX. Training

**I. PATROLS (HAND HELD COMPUTER)**

Distribution Patrols are conducted by a Distribution Inspector that can identify deficiencies or non-standard construction conditions on National Grid facilities. One-fifth of all overhead distribution circuits should be inspected each year. The patrols are scheduled in such a manner that each distribution feeder is examined in the field once every **five** years. The Distribution patrol schedule/status is found in report RPT1310 Feeder Patrol Status. The T&D Superintendents are responsible to create this schedule for their respective Regions. Any new facilities added to the system will be incorporated through our Geographic Information System (GIS) system and added to the appropriate inspection cycle. The Distribution Inspector uses a hand held computer to record region, district, employee ID, feeder number, pole number, tax zone, line number, GPS location, attachments, comments and maintenance problem codes. The Distribution Inspector while patrolling shall also complete maintenance code 118, stencil pole required, if found deficient upon inspection. The Distribution Inspector will input the code into the handheld as required, as well as completing the work unit in the hand held upon field completion while at the site. If the Distribution Inspector finds unmapped facilities from the information supplied from GIS, refer to NG-USA EOP G011, Preparation and Distribution of Electric Facilities Records, for required procedure for corrections.

The maintenance hand held screens are shown in Table I. The Maintenance Problem code listing is shown on the Distribution Field Survey Worksheet (Exhibit 1).

The hand held computer is to be used as the primary vehicle for recording maintenance problems in the field. There will be times where it is not practicable to use the hand held computer due to unfamiliarity or access to one (example: line crew finds maintenance problem and needs to document/record). The method to be used to document/record maintenance in these situations shall be the Distribution Field Survey Worksheet, Exhibit 1. This worksheet must be inputted into the Distribution database through the desk top computer by the inspector, clerk, or supervisor.

**HAND HELD FIELD COMPUTER SCREENS**  
(TABLE I)

<pre>NIAGARA MOHAWK Distribution Patrol Reg:54 Central Dis:14 Fulton Employee#:12345  bat-----ND----- .... MAIN MENU 5.0a 66%-----CY1999----- 03-28-05      11:17a 1-Header 2-Inspect 3-Connect 4-Options 5-Utility</pre>	<pre>Fdr#:33451 :Starr Rd Tax:6067 :T CORTLANDVILLE Map #: Line#:47      02242005 Pole#:51h BROWSE-      462 of 1162  Loc:3PS LASSEN PARK DR/HW Y 252 N:42.358796 W:76.123176 CATV:0 TEL:1 STRLT:Yes  Help Pole Edit Fdr Gps F1 F2 F3 F4 F5</pre>	<pre>{33451} P#:51h BROWSE-      462 of 1162 Code Priority Qty 1:104 B 1 Yr : 2: : 3: : 4: : COM:NEED BUCKET TRUCK FOR STREET LIGHT PROBLEM  Help Edit Quit F1 F3 F5</pre>
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## II. EQUIPMENT TO BE INSPECTED AND MAINTENANCE CODES

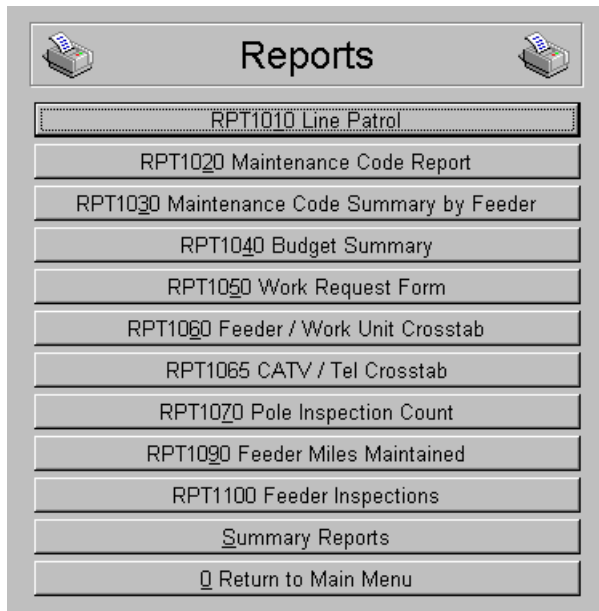
- Wood Pole Mounted Street Light
- Poles
- Crossarms
- Insulators
- Primary
- Transformers
- Capacitor
- Regulator
- Sectionalizer
- Recloser
- Cutout
- Arrester
- Switch
- Ground
- Guy
- Anchor
- Secondary
- Service
- ROW

EXHIBIT 1

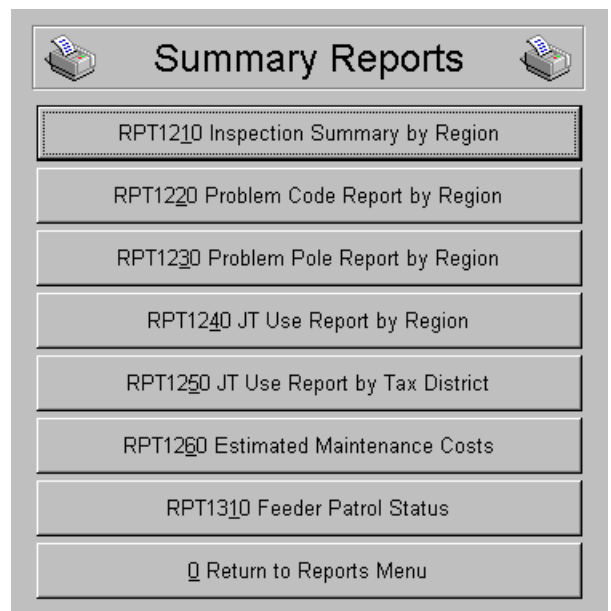
DISTRIBUTION FIELD SURVEY WORKSHEET											
REGION			DISTRICT			EMPLOYEE ID					
FEEDER			TAX DISTRICT/TOWN			MAP #					
LINE#/ROUTE #					POLE#/SUFFIX #						
LOCATION											
NUMBER MAIN LINE CATV ATTACHMENT (Circle One)					NUMBER MAIN LINE TELEPHONE ATTACHMENT (Circle One)					STREET LIGHT ATTACHED (Circle One)	
0 1 2 3 4 5					0 1 2 3 4 5					YES NO	
STREET LIGHT		Priority/ Qty	TRANSFORMER		Priority/ Qty	GUY		Priority/ Qty			
099 A	Not Bonded	/	150 A	Oil Weeping	/	220 B	Guy Wire Marker	/			
100 B	Not Bonded To Standards	/	151 B	Bushings Brk/Cracked	/	221 A	Install/Repl Strain Ins	/			
101 C	Glass Broken/ Damaged	/	152 A	Missing Ground Wire	/	222 B	Excessive Slack	/			
102 C	Arm Broken/Damaged	/	153 B	Lighting Arrester	/	223 B	Broken Wire	/			
103 C	Damaged Head	/	156 B	Non Std Install of Gap	/	225 B	NonStd Bonding/Insul	/			
104 C	Light on Day	/	CAPACITOR			ANCHOR					
105 C	Conductor Repair Req'd	/	160 A	Oil Weeping	/	226 A	Req'd – Jt Owned	/			
POLE			161 A	Bulging	/	227 A	Req'd – Sole NM	/			
106 C	D'bl Wood-NM Trnsf Req'd	/	162 B	Bushgs Brkn/Cracked	/	SECONDARY					
107 I	D'bl Wood-Tel Trnsf Req'd	/	163 A	Missing Ground Wire	/	231 F	In Trees	/			
108 I	D'bl Wood-CATV TrnsfReq'd	/	164 B	Blown Fuse	/	232 B	Improper Sag	/			
110 A	Broken	/	REGULATOR			234 B	Floating	/			
111 B	Visual Rotting Grd Line	/	170 A	Oil Weeping	/	SERVICE					
112 B	Excess Checking	/	171 B	Bushings/Brkn/Crkd	/	240 B	Insul. Loose House	/			
113 B	Cunap Treated Birthmark Year	/	172 A	Missing Ground Wire	/	241 F	In Trees	/			
115 B	Riser Guard Req'd	/	174 B	Ctrl Cab Hght/Grnd		243 B	Non Std/Unsecured NM Action	/			
116 B	Visual Rotting Pole Top	/	SECTIONALIZER			ROW					
117 C	Leaning Pole	/	180 A	Oil Weeping	/	250 F	Brush/Tree	/			
118 A	Stencil /Correction Req'd	/	181 B	Bushings Brkn/Crkd	/						
CROSSARM			182 A	Missing Grd Wire	/						
120 B	Damage Arm	/	183 B	Ctrl Cab Hght/Grnd							
121 B	Loose/Defective Pins	/	RECLOSER								
122 B	Wooden Pins 13.2kv	/	190 A	Oil Weeping	/						
123 B	Loose Brace, Hrdwr	/	191 B	Busings Brkn/Crk	/						
124 B	Dmg Dbl Crossarm	/	192 A	Missing Grd Wire	/						
125 B	Damage Alley Arm	/	193 B	Ctrl Cab Hght/Grd	/						
INSULATOR			CUTOUT								
130 B	Broken/Cracked/ Flashed	/	200 A	Defective Cutout	/						
131 A	Floating	/	ARRESTER								
133 B	Non-Standard Voltage	/	201 B	Blown Arrestors	/						
134 B	I-7 Assoc W/Switch/Fuse		ANIMAL PROTECTION								
PRIMARY			202 B	Animal Guards Req'd	/						
140 A	Insuff. Grnd Clearance	/	SWITCH								
		/	203 B	Gang Operated Defective	/						
141 A	Damaged Cond/Brkn Strands	/	204 B	Single Phase Defective	/						
142 F	In Trees	/	GROUND								
143 B	Space Cable Dmgd Spacr		210 A	Wire Broken/Loose	/						
145 C	Stirrups	/	211 A	Hazard Condition	/						
146 B	Improper Sag	/	212 B	Guard Req'd	/						
147 B	Spacer Cable Bracket Defective	/	213 B	Non Standard							
148 B	Spacer Cable Bracket Not Bonded	/									
Comments:											

### III. MAINTENANCE DATA BASE

The Maintenance data base consists of data down loaded from the hand held, used in the field and data gathered from other sources entered from the desktop computer. The field hand held can be down loaded to any National Grid desk top computer that is connected to the network and the inspector is logged on as a valid user of the T&D Maintenance program. The National Grid desktop computer is also used to generate various reports and work tickets depending on the users need. These reports are utilized to schedule and accomplish distribution maintenance work.



Reports
RPT1010 Line Patrol
RPT1020 Maintenance Code Report
RPT1030 Maintenance Code Summary by Feeder
RPT1040 Budget Summary
RPT1050 Work Request Form
RPT1060 Feeder / Work Unit Crosstab
RPT1065 CATV / Tel Crosstab
RPT1070 Pole Inspection Count
RPT1090 Feeder Miles Maintained
RPT1100 Feeder Inspections
Summary Reports
Return to Main Menu



Summary Reports
RPT1210 Inspection Summary by Region
RPT1220 Problem Code Report by Region
RPT1230 Problem Pole Report by Region
RPT1240 JT Use Report by Region
RPT1250 JT Use Report by Tax District
RPT1260 Estimated Maintenance Costs
RPT1310 Feeder Patrol Status
Return to Reports Menu

### IV. MAINTENANCE

The maintenance activities are scheduled by priority categories, with the exception of “E Priority” which requires immediate repair. All “A Priority” conditions identified prior to November 1 must be repaired/corrected by November 30th. The “B Priority” conditions are scheduled based on the reliability of the circuit, load served, and condition of facilities. The “B Priority” maintenance is to be performed on circuits selected by Distribution Planning and Engineering, and identified in the “Energy Delivery Work Plan”. All “B Priority” maintenance as outlined in the “Energy Delivery Work Plan” must be completed by November 30 of that year. The “C Priority” maintenance work will be completed as planned and directed by the Distribution Planning and Engineering department (Capital expenditures) after reviewing annually for trends that would require expenditures. Any “C Priority” work that is not capital expense will be completed at the discretion of the T&D operating department.

*ALL MAINTENANCE WORK IS TO BE COMPLETED PER NATIONAL GRID DISTRIBUTION STANDARDS.*

**V. WORK MANAGEMENT**

The time recording of both patrol and maintenance activities is accomplished in the Severn Trent Operating Resource Management System (STORMS).

STORMS requires that the Distribution Inspector/Operations Personnel fill out a daily time sheet. The Distribution Inspectors would record their time actually performing the foot patrol inspection of the Distribution system under the DO1100 Activity along with the appropriate work order or a work request if the patrol has been scheduled. Work orders or work request numbers can be obtained from the Operations Supervisor or from the Distribution Planning/Area Resource Coordinator (ARC).

Operations Personnel performing scheduled maintenance on the Distribution System should record their time actually performing maintenance activities under the appropriate work request number set up by their Distribution Planning/ARC in their respective area. Operations Personnel performing maintenance activities that have been not been scheduled should charge the DM1100 activity along with appropriate work order number. STORMS work request numbers are created when the work has been scheduled by Distribution Planning/ARC. Work orders or work request numbers can be obtained from the Operations Supervisor or from the Distribution Planning/ARC.

**VI. COMPLETION**

The replacement/repair of an identified maintenance problem code after completed in the field must be updated in the database. The completion of the maintenance problem codes can be done through the edit screen found on the desktop computer. Field personnel that perform the work are required to complete the work order form providing the date completed, and employee ID number. The work order form is returned to the T&D Supervisor who will close out the completed maintenance problem codes in the database at their desk top computer or designate the inspector or clerk to perform the close out. Additional maintenance problems that maybe discovered and completed by personnel must be noted on the work order ticket so they can be recorded as work completed on that specific facility.

**ALL MAINTENANCE WORK PERFORMED THAT WAS IDENTIFIED ON THE WORK ORDER OR DISCOVERED DURING THE REPAIR/CORRECTION OF THE ORIGINAL MAINTENANCE PROBLEM MUST BE LISTED ON THE DATABASE AND THEN CLOSED OUT WHEN COMPLETE.**

**VII. DEFINITIONS**

Patrol - A walking assessment of National Grid distribution facilities for the purpose of determining the condition of the facility and it's associated components.

Hand Held Computer - An electronic Data recording device that is used in the field to create a record of conditions found.

Desktop Computer – A personal computer that is connected to the National Grid network that is used to download the Hand Held device and retrieve the information in the form of reports.

Distribution Inspector – A line-qualified worker that can identify deficiencies or non-standard construction conditions on National Grid facilities.

Valid User – An individual that has been authorized to use the Transmission and Distribution maintenance program by the program administrator.

### **VIII. RESPONSIBILITIES:**

#### Delivery Engineering Services

1. Update program as necessary.
2. Provide field support and training as requested.
3. Report System Maintenance progress monthly by Region.

#### Field Operations

1. Ensure the Maintenance Program as outlined in this NG-USA EOP 004 is implemented properly and timely.
2. Select circuits to be patrolled for a running five-year cycle.

#### C&MS Management

1. At the request of Field Operations obtain, schedule and manage contractors to perform inspections and perform required maintenance.

#### Distribution Inspector

1. Demonstrate the ability to identify maintenance concerns and the aptitude to become proficient in the use of a hand held computer and desktop computer.
2. Demonstrate the understanding and requirements of this NG-USA EOP D004.
3. Possess the ability to do walking patrols, collect information on a hand held, download to a desk top computer, edit data, provide requested information/reports/work tickets to supervision, and track/close out work completed in the database system.

#### Distribution Asset Strategy

1. Ensure circuits scheduled for patrol are completed each year.
2. Provide input into program revisions.
3. Provide qualified line personnel as inspectors to provide consistent and accurate identified maintenance concerns/problems.
4. Provide program management.

#### Process and Systems

1. Provide and support database.

#### T&D Technical Training

1. Provide training upon request.

**IX. TRAINING:**


1. Delivery Engineering Services with assistance from the database vendor will provide training on the utilization of handheld computers and the selected database.
2. Delivery Engineering Services along with the training department will provide training for the identification of A, B, C, E, and F maintenance items to the qualified employee who will be performing the inspections.

**NG-USA EOP D004**

**“Distribution Line Patrol and Maintenance”**

**Revision 07/25/05**

Revisions throughout this procedure.

 <b>ELECTRIC OPERATING PROCEDURES</b>	<b>Doc No.:</b> NG-USA EOP UG006
	<b>Page:</b> Page 1 of 8
	<b>Date:</b> 07/25/05
<b>SUBJECT:</b> Underground Inspection and Maintenance	<b>SECTION:</b> Underground

#### REFERENCE:

NY PSC Order 04-M-0159  
 Applicable National Grid Safety Rules and Procedures  
 Distribution Line Patrol and Maintenance NG-USA EOP D004  
 Elevated Equipment Voltage Testing NG USA EOP-G016  
 Transmission Line Patrol and Maintenance NG USA EOP – T007

#### GENERAL INFORMATION:

The purpose of this procedure is to outline the requirements for the patrol and maintenance activities associated with National Grid's underground transmission and distribution facilities.  
 The variance in inspection procedures in New York and New England service territories is due to the requirements of New York Public Service Order 04-M-0159, which is incremental to National Grid in New York.

This program is designed for the patrol and designated maintenance of underground facilities on a five year schedule. The Inspector will record all required maintenance on an approved National Grid database.

The underground distribution facility maintenance items identified through this patrol are separated into four priority categories A, B, C, and E priority. The problem codes identified default to the appropriate priority. The default priority can be adjusted by the individual performing the inspection based on actual field conditions. These priority categories are defined as follows:

*A Priority* - An identified facility/component that must be repaired/replaced as soon as practicable.

*B Priority* – An identified facility/component condition that shall be considered for repair/replacement as the feeder is scheduled for maintenance by Distribution Planning and Engineering. These identified conditions will be corrected as preventive maintenance and or facility life extension.

*C Priority* – An identified facility/component condition that is being trended and reviewed by Distribution Planning and Engineering that may require replacement through the engineering process (Requires project/Capital expenditures). Non-capital conditions identified under this priority will be corrected at the discretion of field operations.

*E Priority* – An identified facility/component that must be replaced/repared immediately to address public safety or system reliability. The inspector shall notify the appropriate operations department for immediate response and corrective action any time an E priority is found during an inspection.

***ALL "E" PRIORITY CONDITIONS SHALL BE CORRECTED IMMEDIATELY UPON NOTIFICATION.***

***ALL "A PRIORITY" CONDITIONS IDENTIFIED PRIOR TO NOVEMEBR 1<sup>ST</sup> MUST BE REPAIRED/CORRECTED BY NOVEMBER 30TH.***

Supersedes Document Dated: New Document	Authorized By: Director-Delivery Engrg. Services	Approved By: VP - Engineering Services
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**PROGRAM ADMINISTRATOR:**

Delivery Engineering Services

**APPLICABILITY**

This procedure applies to all personnel involved with or responsible for the inspection or maintenance of underground transmission and distribution facilities.

**SCOPE:**

Distribution Maintenance

- I. Patrols
- II. Equipment to be Inspected and Maintenance Codes
- III. Maintenance database
- IV. Maintenance
- V. Work management
- VI. Completion
- VII. Definitions
- VIII. Responsibilities
- IX. Training

**I. PATROLS****1. New York**

Inspection of underground equipment will be scheduled in such a manner that each Underground Facility will be examined once every five years. These patrols shall be completed by November 30<sup>th</sup> of the schedule year.

One-fifth of all underground utility components should be inspected each year. URD and UCD facilities shall be inspected on the existing overhead distribution circuit schedule. Additionally all riser poles are inspected in accordance with the Transmission and Distribution Overhead Inspection Programs, NG-USA EOP T007 and NG-USA EOP D004. Customer owned manholes and vaults that enclose National Grid equipment shall require the inspection of these National Grid facilities.

The T&D Superintendent's are responsible to create the patrol schedule for their respective Regions for the remainder of underground facilities. The Distribution Inspector uses a hand held computer to record region, district, employee ID, feeder number, structure ID number, GPS location, tax zone, line number, comments and maintenance problem codes. The Inspector while patrolling shall also complete the following maintenance codes if found deficient upon inspection: 617 – manhole missing nomenclature, 639 - network transformer- missing nomenclature, 660 – switchgear missing nomenclature, 681 – transformer missing nomenclature, 707 – vaults improper nomenclature. The Inspector will input the code into the handheld as required, as well as completing the work unit in the handheld upon field completion while at the site. If the Distribution Inspector finds unmapped facilities from the information supplied from the Geographic Information System (GIS), refer to NG-USA EOP G011, Preparation and Distribution of Electric Facilities Records, for required procedure for corrections.

## **2. New England - Massachusetts, New Hampshire and Rhode Island**

Inspection of designated underground equipment will be scheduled in such a manner that each designated Underground Facility will be examined once every five years. These patrols shall be completed by November 30<sup>th</sup> of the schedule year.

One-fifth of all metallic handhole covers, padmount transformers and switchgear shall be inspected annually. These facilities shall be opened for a visual inspection. Additionally all separable components in these facilities are to be inspected by infrared. Refer to NG-USA EOP UG001 for infrared procedure. An “E Priority” shall be assigned to a temperature gradient greater than 20°. An “A Priority” shall be assigned to a temperature gradient between 10° and 20°. A “B Priority” shall be assigned to a temperature gradient less than 10°. Additionally, an elevated equipment voltage test shall be completed at each location, refer to NG-USA EOP-G016.

A working inspection on underground facilities is required for all manholes, vaults, handholes, splice boxes, junction boxes, padmount transformers, switchgear and submersible equipment, each time a crew performs work at one of these facilities. The format for data collected shall follow this EOP. Additionally an elevated equipment voltage test shall be completed at each location, refer to NG-USA EOP-G016.

All transmission riser poles are inspected in accordance with the Transmission NG-USA EOP-T007.

The T&D Superintendent’s are responsible to create the patrol schedule for their respective Regions for the designated underground facilities. The Distribution inspector uses a hand held computer to record region, district, employee ID, feeder number, structure ID number, GPS location, line number, comments and maintenance problem codes. The Inspector, while patrolling or crew while inspecting, shall also complete the following maintenance codes if found deficient upon inspection, 617 – manhole missing nomenclature, 639 - network transformer- missing nomenclature, 660 – switchgear missing nomenclature, 681 – transformer missing nomenclature, 707 – vaults improper nomenclature. The Inspector will input the code into the handheld as required, as well as completing the work unit in the handheld upon field completion while at the site. If the Distribution Inspector finds unmapped facilities from the information supplied from GIS, refer to NG-USA EOP G011, Preparation and Distribution of Electric Facilities Records, for required procedure for corrections. Crews performing working inspections are to follow the same protocol for inspections by using either a handheld data entry unit or paper inspection logs requiring data entry by clerical support.

## **II. EQUIPMENT TO BE INSPECTED AND MAINTENANCE CODES**

This EOP requires the visual inspection of the following facilities as designated above for either New York or New England, which require opening, and may require pumping on some items to assure a proper inspection:

- Manholes
- Vaults
- Handholes – non-fiberglass
- Splice boxes
- Junction boxes
- Pad mount transformers
- Pad mount switchgears
- Submersible equipment
- Handholes – fiberglass do not require opening

Table 1 on page 4 details the Inspection Program and Maintenance Codes.

**INSPECTION PROGRAM AND MAINTENANCE CODES****TABLE 1**

Maintenance Code	Description	Expense or Capital	Default priority
600	Handholes - Broken/damaged/unsecured	E	B
602	Handholes - Missing nomenclature	E	C
603	Handholes - Secondary needs repair	E	B
604	Handholes – Other (use comments)	E	B
605	Infrared Inspection – Separable Components	E	B
610	Manhole - Bonded	E	B
611	Manholes - Cable/Joint leaking	E	A
612	Manholes - Cables bonded	E	B
614	Manholes - Cracked/broken	C	B
615	Manholes - Fire proofing	E	C
616	Manholes - Improper grade	E	B
617	Manholes - Missing nomenclature	E	A
620	Manholes - Rerack	E	B
621	Manholes - Ring/cover repair/replace	C	B
630	Network Protector - Barriers broken/dama	E	A
632	Network Protector - Oil leak	E	A
633	Network Protector - Worn/damaged gasket	E	A
635	Network transformer - Bushing Broken/Cra	E	B
637	Network transformer - Low oil	E	B
638	Network transformer - Missing Ground	E	A
639	Network transformer - Missing nomenclature	E	A
642	Network transformer - Oil Weeping	E	A
643	Network transformer - Rusted/ Paint peel	E	C
651	Switchgear - Barrier broken/damaged/unsecured	E	A
652	Switchgear - Base broken/damaged	C	B
654	Switchgear - Cable Not Bonded	E	A
656	Switchgear - Door Broken/Damaged	E	A
657	Switchgear – Excessive vegetation	E	C
659	Switchgear - Missing ground	E	A
660	Switchgear - Missing Nomenclature	E	A
661	Switchgear – Other	E	C
662	Switchgear - Rusted/Paint peeling	E	C
672	Transformer - Bushing Broken/Cracked	E	B
673	Transformer - Door Broken/damaged/unsecured	E	A
675	Transformer - Elbows tracking/burned	E	B
676	Transformer – Excessive vegetation	E	C
680	Transformer - Missing Ground	E	A
681	Transformer - Missing nomenclature	E	A
682	Transformer – Mud/debris	E	C
684	Transformer - Oil Weeping	E	A
685	Transformer - Pad broken/damaged	E	B
686	Transformer - Protection (ballards) damaged	C	B
687	Transformer - Rusted/ Paint peeling	E	C
690	Trench - Exposed Cable	E	A
692	Trench Path - Sunken	E	B

700	Vaults - Cable missing bond	E	A
702	Vaults - Cracked/broken	C	B
703	Vaults - Damaged/broken cover	E	B
704	Vaults - Damaged/broken door	E	B
705	Vaults - Damaged/broken ladder	E	A
706	Vaults - Improper grade	E	B
707	Vaults - Improper nomenclature	E	A
708	Vaults - Light not working	E	B
713	Vaults - Ventilation failure	E	B
720	Submersible equip. - Excess corrosion	E	C
721	Submersible equip. - Physical damage	E	C
722	Submersible equip. - Leaking	E	C
730	Anodes - Missing	E	C
731	Anodes - Need replacement	C	C

### **III. MAINTENANCE DATABASE**

The Maintenance database consists of data downloaded from the hand held and data entered from the desktop computer. The field hand held can be downloaded to any National Grid desk top computer that is connected to the network and the inspector is logged on as a valid user of the UG Maintenance program. The National Grid desktop computer is also used to generate various reports and work tickets depending on the user's need. These reports are utilized to schedule and accomplish distribution maintenance work.

### **IV. MAINTENANCE**

The maintenance activities are scheduled by priority categories with all "A Priority" conditions identified prior to November 1 repaired/corrected by November 30th. The "B Priority" conditions are scheduled based on the reliability of the circuit, load served, and condition of facilities. The "B Priority" maintenance is to be performed on circuits selected by Distribution Planning and Engineering, and identified in the "Energy Delivery Work Plan". All "B Priority" maintenance as outlined in the "Energy Delivery Work Plan" must be completed by November 30 of that year. The "C Priority" maintenance work will be completed as planned and directed by the Distribution Planning and Engineering department (Capital expenditures) after reviewing annually for trends that would require expenditures. All "E Priority" conditions shall be responded to immediately upon notification for correction.

### **V. WORK MANAGEMENT**

The time recording of both patrol and maintenance activities is accomplished in the Severn Trent Operating Resource Management System (STORMS).

STORMS requires that the Distribution Inspector/Operations Personnel fill out a daily time sheet. The Distribution Inspector would record their time actually performing the foot patrol inspection of the Distribution system under the DO2105 Activity along with the appropriate work order or a work request if the patrol has been scheduled. For Transmission and Sub-transmission facilities the inspector shall utilize activity TO2100. Work orders or work request numbers can be obtained from the Operations Supervisor or from the Distribution Planning/Area Resource Coordinator (ARC).

Operations Personnel performing scheduled maintenance on the Distribution System should record their time actually performing maintenance activities under the appropriate work request number set up by their Distribution Planning/ARC in their respective area. Operations Personnel performing maintenance activities that have not been scheduled should charge the DM2105 activity along with appropriate work order number.

For Transmission and Sub-transmission utilize activity TM2100. STORMS work request numbers are created when the work has been scheduled by Distribution Planning/ARC. Work orders or work request numbers can be obtained from the Operations Supervisor or from the Distribution Planning/ARC.

## **VI. COMPLETION**

The replacement/repair of an identified maintenance problem code after completion in the field must be updated in the database. The completion of the maintenance problem codes can be done through the edit screen found on the desktop computer. Field personnel that perform the work are required to complete the work order form providing the date completed, and employee ID number. The work order form is returned to the T&D Supervisor who will close out the completed maintenance problem codes in the database at their desktop computer or designate the inspector or clerk to perform the close out. Additional maintenance problems that may be discovered and completed by personnel must be noted on the work order ticket so they can be recorded as work completed on that specific facility.

ALL MAINTENANCE WORK PERFORMED THAT WAS IDENTIFIED ON THE WORK ORDER OR DISCOVERED DURING THE REPAIR/CORRECTION OF THE ORIGINAL MAINTENANCE PROBLEM MUST BE LISTED ON THE DATABASE AND THEN CLOSED OUT WHEN COMPLETE.

## **VII. DEFINITIONS**

**Desktop Computer:** A personal computer that is connected to the National Grid network and used to download the Hand Held device and retrieve the information in the form of reports.

**Elevated Equipment Voltage Test:** An A.C. rms voltage difference between utility equipment and the earth, or to nearby grounded facilities that exceeds the highest perceptible voltage levels for humans.

**Hand Held Computer:** An electronic data recording device that is used in the field to create a record of conditions found.

**Hand-Hole:** An enclosure identified for use in underground systems, provided with an open or closed bottom, and sized to allow personnel to reach into, but not enter, for the purpose of installing, operating, or maintaining equipment or wiring or both.

**Infrared Inspection:** An inspection conducted to detect abnormal heating conditions associated with separable connectors. An infrared inspection is required before work begins in an enclosed space, enclosure, padmounted transformer or padmounted switchgear.

**Inspector:** An underground qualified worker who can identify deficiencies or non-standard construction conditions on National Grid facilities.

**Manhole:** An enclosure identified for use in underground systems, provided with an open or closed bottom, and sized to allow personnel to enter, for the purpose of installing, operating, or maintaining equipment or wiring or both.

**Patrol:** An assessment of National Grid facilities for the purpose of determining the condition of the facility and any associated components.

**Service Box:** See Hand-hole

**Submersible Equipment:** Electric equipment such as transformers and switches that, are generally located within a Hand-hole, Manhole, or Vault.

**URD:** Underground Residential Distribution

**UCD:** Underground Commercial Distribution

**Underground Distribution Facilities:** Manholes, vaults, hand-holes and service boxes, padmounted equipment and the components and equipment contained in these structures. (See GENERAL INFORMATION above).

**User:** An individual who the program administrator has authorized to use the inspection reporting program.

**Vault:** An enclosure, above or below ground, which personnel may enter and which is used for the purpose of installing, operating, or maintaining equipment or wiring or both.

## **VIII. RESPONSIBILITIES**

### Delivery Engineering Services

1. Update program as necessary.
2. Provide field support and training as requested.
3. Report System Maintenance progress monthly by Region.

### Field Operations

1. Ensure the Underground Maintenance Program as outlined in this EOP is implemented properly and timely.
2. Select circuits to be patrolled for a running five-year cycle and ensure that the circuits scheduled for patrol are completed each year.
3. Provide qualified personnel as the inspectors, to provide consistent and accurate identified maintenance concerns/problems.

### Distribution Inspector

1. Demonstrate the ability to identify maintenance concerns and the aptitude to become proficient in the use of a hand held computer and desktop computer.
2. Demonstrate the understanding and requirements of this EOP.
3. Possess the ability to do walking patrols, collect information on a hand held, download to a desktop computer, edit data, provide requested information/reports/work tickets to supervision, and track/close out work completed in the database.

### C&MS

1. At the request of Field Operations obtain, schedule and manage contractors to perform inspections and perform required maintenance.

### Distribution Network Strategy

1. Provide inspectors where applicable.
2. Provide input into program revisions.
3. Provide program management.
4. Ensure program is completed annually as required.
5. Ensure inspectors are trained.

### Process and Systems

1. Provide and support database.

T&D Technical Training

1. Provide training upon request.

**IX. TRAINING**

1. Delivery Engineering Services with assistance from the database vendor will provide training on the utilization of handheld computers and the selected database.
2. Delivery Engineering Services along with the training department will provide training for the identification of A, B, C, and E maintenance items to the qualified employee who will be performing the inspections.

**NG-USA EOP UG006**

**“Underground Inspection and Maintenance”**

**07/25/05**

This is a new procedure.

<b>nationalgrid</b>  <b>ELECTRIC OPERATING PROCEDURES</b>	<b>Doc No.</b> NG-USA EOP T007
	<b>Page</b> 1 of 10
	<b>Date</b> 07/25/05
<b>SUBJECT:</b> Transmission Line Patrol & Maintenance 23kV-345kV	<b>SECTION</b> Transmission & Distribution

**REFERENCE:**

NY PSC Order 04-M-0159  
Applicable National Grid Safety Rules and Procedures  
Elevated Equipment Voltage Testing NG-USA EOP G016

**GENERAL INFORMATION:**

The purpose of this procedure is to outline the requirements for the patrol and maintenance activities associated with National Grid USA Transmission circuits. The Transmission Maintenance Program is designed to address a variety of maintenance activities required to maintain a safe and reliable Transmission System. Due to the diverse service territories, system construction and voltages, National Grid will utilize the following definitions below to designate which maintenance activities in this EOP are completed in the sections discussed.

- Transmission NY 115kV and above
- Sub-transmission NY 23kV up to and including 69kV
- Transmission New England 69kV and above
- Sub-transmission New England 23kV up to and including 46kV

These patrol and maintenance activities include a ground based patrol on a five year cycle, aerial Infrared on a three year cycle, Transmission Tower footing inspection and repair on a twenty year cycle, Transmission Wood Pole Inspection and Treatment on a ten year cycle, general aerial patrols on a one year cycle, Comprehensive Helicopter Inspections as needed, and Transmission Tower Painting on a twenty year basis. Elevated Equipment Voltage testing on Transmission and Sub-transmission facilities is covered by EOP G016.

**APPLICABILITY:**

This procedure applies to all personnel involved with or responsible for the inspection and repair of Transmission facilities.

**PROGRAM ADMINISTRATOR:**

Delivery Engineering Services

<b>Supersedes Document Dated:</b> 02/01/02 EOP 211	<b>Authorized By:</b> Director – Delivery Engineering Services	<b>Approved By:</b> VP – Network Asset Management
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**SCOPE:**

## Transmission Maintenance

- I. Ground Based Patrol and Maintenance
- II. Aerial Helicopter Patrol
- III. Tower Footing Inspection and Repair
- IV. Wood Pole Inspection and Treatment
- V. Aerial Helicopter Infrared Patrols
- VI. Comprehensive Helicopter Patrol
- VII. Tower Painting
- VIII. Maintenance Database
- IX. Maintenance
- X. Time Reporting
- XI. Completion
- XII. Definitions
- XIII. Responsibilities
- XIV. Training

**I. GROUND BASED PATROL INSPECTION AND MAINTENANCE****Transmission****Sub-transmission**

1. Transmission patrols are conducted by a line qualified worker that can identify hazards, deficiencies or non-standard construction conditions on National Grid facilities. The patrols are scheduled in such a manner that each transmission circuit is examined in the field once every **five** years. Any new facilities added to the system will be incorporated through our Geographic Information System and added to the appropriate inspection cycle.

The patrols are conducted by an Inspector identifying all required maintenance on a hand held computer. The maintenance items identified through this patrol are separated into five priority categories A, B, C, E and F priority. The problem codes identified default to the appropriate priority. The default priority can be adjusted by the individual performing the inspection based on actual field conditions. These priority categories are defined as follows:

*A Priority* - An identified facility/component or tree condition that must be repaired/replaced as soon as practicable.

*B Priority* – An identified facility/component condition that shall be considered for repair/replacement as the circuit is scheduled for maintenance by Transmission Asset Management. These identified conditions will be corrected as preventive maintenance and or facility life extension.

*C Priority* – An identified facility/component condition that is being trended and reviewed by Transmission Asset Management annually that may require replacement through the engineering process (requires project/capital expenditures). Non-capital conditions identified under this priority will be corrected at the discretion of field operations in consultation with Transmission Asset Management.

*E Priority* – An identified facility/component that must be replaced/repared immediately to address public safety or system reliability. The inspector shall notify the appropriate operations department for immediate response and corrective action any time an E priority is found during an inspection.

*F Priority* – An identified forestry condition that should be scheduled as time permits, within the routine

right-of-way maintenance and danger tree removal schedules.

*ALL "A PRIORITY" CONDITIONS IDENTIFIED PRIOR TO NOVEMBER 1<sup>ST</sup> MUST BE REPAIRED/CORRECTED BY NOVEMBER 30<sup>TH</sup>*

*ALL "E PRIORITY" CONDITIONS SHALL BE CORRECTED IMMEDIATELY UPON NOTIFICATION.*

*ALL "F PRIORITY" CONDITIONS IDENTIFIED DURING THE PATROL ARE TRANSMITTED TO THE SYSTEM FORESTRY GROUP ON AN ANNUAL BASIS FOR INCLUSION IN THE RIGHT-OF-WAY MAINTENANCE PROGRAM.*

The Transmission patrol schedule/status is created and tracked by report RPT 3100 Circuit Patrol Status.

The T&D Superintendent's or Transmission Line Services management are responsible to create this schedule for their respective areas. The inspector uses a hand held computer to inspect scheduled circuits recording area, district, employee ID, circuit, pole number, GPS location, type, material make up, condition of steel/concrete, wood pole inspection year and treatment, specific pole information, maintenance problem codes and comments. The Maintenance Problem code listing is shown on the Transmission Field Survey Worksheet (Exhibit 1). The material make up screen will also include prompts for condition information when either steel or lattice is chosen. The condition rating for steel will be on a 1 to 6 scale and concrete condition will be on a 1-5 scale. These scales are as shown:

Steel Condition

1	Serviceable
2	Intact
3	Light Corrosion
4	Light Pitting
5	Significant Pitting
6	Very Severe Deterioration

Concrete Condition

1	Serviceable
2	Light Deterioration
3	Medium Deterioration
4	Severe Deterioration
5	Very Severe Deterioration

The Inspector, while patrolling, shall also complete maintenance codes "532 – Tower numbers missing" and "581 – stencil required", if found deficient upon inspection. For these two codes, the Inspector will input the code into the handheld as required, as well as completing the work unit in the handheld upon field completion while at the site.

The hand held computer is to be used as the primary vehicle for recording maintenance problems in the field. There will be times where it is not practicable to use the hand held computer due to unfamiliarity or access to one (example: line crew finds maintenance problem and needs to document/record). The method to be used to document/record maintenance in these situations shall be the Transmission Field Survey worksheet, Exhibit 1. This worksheet must be entered into the Transmission database through the desk top computer by inspector, clerk, or supervisor.

## EXHIBIT 1

## TRANSMISSION FIELD SURVEY WORKSHEET

Patrolled Circuit/No.	Unique ID	Pole/Tower No.		Voltage	District
Additional Circuit/No.	Unique ID				
Area	Between _____ Rd. And _____ Rd.	Date	Employee ID		
TYPE	A) Single      B) H. Frame      C) 3 Pole      D) 4 Pole      E) 5 Pole      F) 6 Pole G) Flex-Tower      H) Square-Tower      I) Hairpin      J) Other				
MATERIAL	A) Wood (fill in information for each pole i.e 2 pole, 3 pole, 4 pole, etc.) Height _____ Class _____ Year Set _____ Manufacturer _____ Year Last Treated _____ Treatment A) External B) Internal C) Both D) Other E) Unknown F) None B) Steel      C) Lattice				
CONFIGURATION	Deadend	Tanget	Switch Structure	Davit Arm	Stand Off      Other
STEEL/LATTICE CONDITION	(Circle One) 1   2   3   4   5   6		FOUNDATION:      STEEL CONCRETE	(Circle One) 1   2   3   4   5   6 1   2   3   4   5	
POLE *	Sub. No.	Priority/ QTY	CONDUCTOR **		Circuit No.      Priority/ QTY
510 A      BROKEN		/	541 B      CONDUCTOR		/
511 B      VISUAL ROTTING		/	542 B      STATIC		/
512 C      LEANING		/	543 A      GROUND WIRE		/
513 B      REPLACE SINGLE ARMS		/	544 B      SLEEVE/CONN		/
514 B      REPL DOUBLE ARM		/	545 B      RESAG		/
515 B      REPAIR BRACES		/	546 B      UNDER 25 FT.		/
516 B      REPLACE BRACES		/	LINE HARDWARE		
517 B      REPLACE ANCHOR		/	551 B      INSULATORS/DAM		/
518 B      INSTALL ANCHOR		/	552 B      INSULATOR PLUMB		/
519 B      REPAIR/REPLACE GUY WIRE		/	553 B      HARDWARE DAM		/
521 B      TIGHTEN GUY WIRE		/	555 I      LIGHTING ARRESTOR		/
522 B      REPLACE/INSTALL GUY SHIELD		/	FOUNDATION – GENERAL		
524 B      GUY NOT BONDED		/	563 B      EROSION		/
525 B      LIGHTNING DAMAGE		/	RIGHT OF WAY		
526 B      WOODPECKER DMG		/	571 F      EROSION		/
527 B      INSECTS		/	572 F      ENCROACHMENTS		/
TOWER			573 F      DEBRIS		/
531 A      TOWER LEGS BROKEN		/	574 F      DANGER TREE		/
532 A      NUMBERS MISSING		/	575 F      GATE BROKE		/
534 B      LOOSE BOLTS/HARD		/	576 A      OIL/GAS LEAK		/
535 B      REPAIR ANTI-CLIMB		/	MISCELLANEOUS		
536 F      VEGETATION ON TOWER		/	581 A      STENCIL STRUCTURE		/
537 B      STRUCTURE DAMAGE		/	582 B      SWITCH DAMAGED		/
538 B      STRAIGHTEN TOWER		/	583 B      DAMAGED GROUND		/
539 B      ARMS DAMAGED		/	584 B      INSTALL WRNG SIGN		/
* Enter Sub. No. if a multiple Structure		/	585 B      REPLACE SIGNS		/
** Enter Circuit No. if more than circuit on pole		/	586 B      REMOVE STEPS		/
		/	587 B      ADD DIRT & TAMP		/

**SUBJECT:** Transmission Line Patrol & Maintenance 23kV-345Kv

**Doc. No.** NG-USA EOP T007

**Date:** 07/25/05

Comments:

## 2. EQUIPMENT TO BE INSPECTED AND MAINTENANCE CODES

- Towers
- Poles
- Crossarms
- Insulators
- Switches
- Reclosers & Sectionalizers
- Conductor
- Grounds
- Guys
- Anchors
- Risers
- Foundations
- ROW

## II. AERIAL HELICOPTER PATROL

### Transmission

### Sub-transmission NY

Aerial Helicopter Patrols shall be done on a one-year cycle providing for a visual examination of all Transmission lines. This patrol shall be accomplished by a line-qualified worker recording items such as broken or flashed insulators, leaning structures, broken hardware, tree conditions, ROW problems, and conductor clearance problems. Any item that is observed that might affect the operation, reliability, or safety of the general public must be reported and documented. The use of Exhibit I as a template along with a tape recorder during flight is highly recommended. Conditions/Maintenance problems identified are to be prioritized "A, B, C, E, F" as described in this procedure and must be entered into the database for scheduling and tracking. Additional guidance for tree and insulator problems is shown in Table III and IIIA.

### **TREE CLEARANCE** **(TABLE III)**

#### **Priority A**

#### **Voltage**

#### **Vertical or Lateral Clearance**

23-46 kV	4' or less
69 kV	6' or less
115 kV	10' or less
230 kV	14' or less
345 kV	18' or less

**INSULATOR GUIDANCE TABLE**  
**(TABLE IIIA)**

	<b><u>Number of Good Vertical Insulators in String</u></b>
<b><u>Priority A:</u></b>	
<b><u>Voltage</u></b>	
115 KV	4 or less out of 7
230 KV	7 or less out of 14
345 KV	10 or less out of 17
<b><u>Priority B:</u></b>	
<b><u>Voltage</u></b>	
115 KV	5 or less out of 7
230 KV	9 or less out of 14
345 KV	12 or less out of 17
<b><u>Priority C:</u></b>	
<b><u>Voltage</u></b>	
115 KV	6 or more
230 KV	10 or more
345 KV	13 or more

**III. TOWER FOOTING INSPECTION AND REPAIR**  
**Transmission**

The tower footing inspection and repair maintenance activity is scheduled for a 20-year cycle. This activity consists of excavating the tower footing a minimum of 24" below grade, cleaning the footer, visual inspection, welding or concrete repair if required, application of a protective coating, backfill and compact soil.

**IV. WOOD POLE INSPECTION AND TREATMENT**  
**Transmission**

The wood pole inspection and treatment maintenance activity is scheduled for a 10-year cycle. This activity consists of excavating the base of a wood pole 18" below grade, shaving/removal of any decayed wood, measurements of the circumference, drilling, measurements for voids, evaluate pole strength per NESC requirements, treat with preservatives, plug drilled holes, backfill and compact soil and perform an overall visual inspection of the structure.

**V. AREIAL HELICOPTER INFRARED PATROLS**  
**Transmission**  
**Sub-transmission NY**

The Aerial Helicopter Infrared Patrol maintenance activity is scheduled for a 3-year cycle with bulk power circuits done yearly. This activity consists of an aerial viewing of transmission line components through a thermal imaging camera. Transmission components found with a temperature between 1 and 20 degrees Centigrade above the "reference temperature"\* should be monitored for change and addressed accordingly. Components found to be greater than 20 degrees Centigrade above the "reference temperature" are to be addressed within the next year. Transmission components found to be greater than 40 degrees Centigrade above the reference temperature are to be addressed as soon as possible as system operating conditions

allow. In order to verify the location of the component identified by IR with a temperature anomaly, it is suggested that repair crews utilize a live line micro ohmmeter, such as the SensorLink Corp. Ohmstik, as a confirmation tool.

\*Reference Temperature – Reference Temperature refers to the normal real time operating temperature of the conductor or apparatus, which includes all influences that create this temperature such as load, weather and condition. The thermovision camera must have the capability to accurately detect the temperature differential, in degrees C, between the “hot spot” temperature and the nearest point which reflects the expected reference temperature, so as to identify and prioritize the defects found.

## **VI. COMPREHENSIVE HELICOPTER PATROL**

### **Transmission**

The Comprehensive Helicopter Patrol maintenance activity is a comprehensive methodical examination of all components comprising the transmission system by helicopter. The patrol is documented on a structure by structure component based in a data format with pictures. Components that are identified as critical carry the same definitions as “A Priority” work. This type of maintenance activity is conducted on an as needed basis to identify specific problems, reliability issues, or to document condition for planned rebuilds or upgrades.

## **VII. TOWER PAINTING**

### **Transmission**

The Tower painting maintenance activity consists of applying a protective coating system to steel transmission structures. This activity is usually scheduled on a 20-year basis to extend the service life of the steel or meet specific aerial marking requirements per FAA regulations.

## **VIII. MAINTENANCE DATA BASE**

The Maintenance database consists of information (data) downloaded from the hand held and information (data) entered from the desktop computer. The field hand held can be down loaded to any National Grid desk top computer that is connected to the network, and is logged on as a valid user of the T&D Maintenance program. The National Grid desktop computer is also used to generate various reports and work tickets depending on the users needs. These reports are utilized to schedule and accomplish transmission maintenance work.

## **IX. MAINTENANCE**

The maintenance activities are scheduled by priority categories. “E Priority” requires immediate repair. All “A Priority” conditions identified prior to November 1 must be repaired/corrected by November 30th. The “B Priority” conditions are scheduled based on the reliability of the circuit, load served, Line Importance Factor, and condition of facilities. The “B Priority” maintenance is to be performed on circuits selected by Transmission Asset Management (transmission) and Distribution Network Strategy (sub-transmission) and identified in the “Energy Delivery Work Plan”. All “B Priority” maintenance as outlined in the “Energy Delivery Work Plan” must be completed by November 30 of that year. The “C Priority” maintenance work will be completed as planned and directed by Transmission Asset Management and Distribution Network Strategy (Capital expenditures) after reviewing annually for trends that would require expenditures. Any “C Priority” work that is not capital expense will be completed at the discretion of the T&D Operating department in consultation with Transmission Asset Management or Distribution Network Strategy.

*ALL MAINTENANCE WORK IS TO BE COMPLETED PER NATIONAL GRID STANDARDS.*

## **X. TIME REPORTING**

The time recording of both patrol and maintenance activities is accomplished in the Severn Trent Operating Resource Management System (STORMS).

STORMS requires that the Transmission Inspector/Operations Personnel fill out a daily time sheet. The Transmission Inspector would record their time actually performing the foot patrol inspection of the Transmission and Sub-transmission system under the TO1160 Activity along with the appropriate work order or a work request if the patrol has been scheduled. Work orders or work request numbers can be obtained from the Operations Supervisor or from the Transmission Planning/Area Resource Coordinator (ARC).

Operations Personnel performing scheduled maintenance on the Transmission and Sub-transmission systems should record their time actually performing maintenance activities under the appropriate work request number set up by their Transmission Planning/ARC in their respective area. Operations Personnel performing maintenance activities that have not been scheduled should charge the TM1160 activity along with appropriate work order number. STORMS work request numbers are created when the work has been scheduled by Transmission Planning/ARC. Work orders or work request numbers can be obtained from the Operations Supervisor or from the Transmission Planning/ARC.

## **XI. COMPLETION**

The replacement/repair of an identified maintenance problem code must be completed in the database upon field completion. The completion of the maintenance problem codes can be done through the edit screen found on the desktop computer. Field personnel that perform the work are required to complete the work order form providing the date completed, and employee ID number. The work order form is returned to the T&D Supervisor or Transmission Line Services Supervisor who will close out the completed maintenance problem codes in the database at their desk top computer or designate the inspector or clerk to perform the close out. Additional maintenance problems that maybe discovered and completed by personnel must be noted on the work order ticket so they can be recorded as work completed on that specific facility.

*ALL MAINTENANCE WORK PREFORMED THAT WAS IDENTIFIED ON THE WORK ORDER OR DISCOVERED DURING THE REPLACEMENT/REPAIR/CORRECTION OF THE ORGINAL MAINTENANCE PROBLEM MUST BE LISTED ON THE DATABASE AND THEN CLOSED OUT WHEN COMPLETE.*

## **XII. DEFINITIONS:**

Ground Based Patrol - A walking/vehicle assessment of National Grid transmission facilities for the purpose of determining the condition of the facility and its associated components.

Hand Held Computer - An electronic Data recording device that is used in the field to create a record of conditions found.

Desktop Computer – A personal computer that is connected to the National Grid network that is used to down load the Hand Held device and retrieve the information in the form of reports.

Transmission Inspector – A line-qualified worker that can identify deficiencies or non-standard construction conditions on National Grid facilities.

Aerial Infrared – Helicopter based thermographic imaging of connections and equipment.

Tower Footing – Embedded support structure that supports a Transmission tower.

Aerial Patrols – Helicopter based visual examination of Transmission facilities and equipment.

Comprehensive Helicopter Patrol – A comprehensive methodical examination of all components comprising the transmission system by helicopter.

### **XIII. RESPONSIBILITIES**

#### Delivery Engineering Services

1. Update program as necessary.
2. Provide field support and training as requested.
3. Report System Maintenance progress monthly.

#### Field Operations/Transmission Line Services

1. Ensure the Maintenance Program as outlined in this NG-USA EOP T007 is implemented properly and timely.
2. Select circuits to be patrolled for a running five-year cycle and ensure that the circuits scheduled for patrol are completed each year.
3. Provide a qualified line personnel as the inspector, to provide consistent and accurate identified maintenance concerns/problems.

#### C&MS Management

1. At the request of Field Operations obtain, schedule and manage contractors to perform inspections and perform required maintenance.

#### Inspector

1. Demonstrate the ability to identify Transmission maintenance concerns and the aptitude to become proficient in the use of a hand held computer and desktop computer.
2. Demonstrate the understanding and requirements of this NG-USA EOP T007.
3. Possess the ability to do walking patrols, collect information on a hand held, down load to a desk top computer, edit data, provide requested information/reports/work tickets to supervision, and track/close out work completed in the database system.

#### Distribution Network Strategy

1. Provide input into program revisions.
2. Provide qualified personnel to complete inspection where applicable.
3. Ensure the program as outlined in this EOP is completed each year where applicable.
4. Ensure inspectors are trained where applicable.
5. Provide program management.

#### Process and Systems

1. Provide and support database.

#### T&D Technical Training

1. Provide training upon request.

Transmission Network Asset Strategy

1. Provide input into program revisions.
2. Provide schedule for Tower Footing Inspection, Wood Pole Inspection and Treatment, Aerial Helicopter Infrared Patrols, Comprehensive Helicopter Patrols, and Tower Painting.

**XIV. TRAINING**

1. Delivery Engineering Services with assistance from the database vendor will provide training on the utilization of handheld computers and the selected database.
2. Delivery Engineering Services along with the training department will provide training for the identification of A, B, C, E, and F maintenance items to the qualified worker who will be performing the inspections.

**NG-USA EOP T007**

**“Transmission Line Patrol – 23kV-345Kv”**

**Revision 07/25/05**

Supersedes EOP 211 dated 02/01/02.

Record Request DTE-7

Request:

Each company is requested to provide the details of their training requirements for internal and external employees and contractors who are likely to perform work on the company's electric or gas distribution system.

Response:

The National Grid USA Service Company ("Service Company") provides services in response to requests from its affiliates, including Mass. Electric and Nantucket. Resources may be drawn from a wholly internal workforce, from the external marketplace, or a combination of the two. Internal staffing is occasionally augmented by small numbers of building trade members hired (temporarily) under Letters of Assent from the local union halls. The combination of Service Company and contractor crews perform the majority of substation and transmission line construction.

In addition to Service Company personnel, Mass. Electric maintains a well trained internal physical workforce which performs much of the routine distribution construction. The contracted workforce is managed by the Service Company's Construction and Maintenance Services Department. Contractors repair, modify, and in some cases construct substation and transmission line facilities.

The internal workforce receives its technical training through negotiated progression plans (see the attached "Electrical Department Progression Plan"), which include classroom training and testing, in field reviews, and a proficiency check process. Only through formal training and an on-the-job experience can an internal employee become qualified to perform all aspects of the work.

Progression through the electrical roster begins at Electrician 3<sup>rd</sup> Class, with duties which include assembly of conduit and other more 'mechanical' tasks. An Electrician 2<sup>nd</sup> Class must be on the Company's 'Red Tag' list, which requires successful completion of three days of Switching and Tagging instruction. At the next step in the progression process, an Electrician 1<sup>st</sup> Class is required to demonstrate that he/she has the skills necessary to tag out systems or circuits and demonstrate a basic understanding of the Company's construction standards. Prior to progressing from Electrician 1<sup>st</sup> Class to Construction Electrician, employees are encouraged to pass a written and practical test administered by the Board of State Examiners and receive a Journeyman's (Electrician) license. Limited progression to the ultimate rate (Switchboard Wireman) carries its own set of requirements, as shown in the attached progression plan. An additional 2 to 5 years of field experience in construction or maintenance is needed before a represented employee is considered ready to lead a crew and can be promoted to the Working Leader classification.

Progression from Electrician 3<sup>rd</sup> Class to Construction Electrician, as outlined above and in the attached progression plan, requires a minimum of five years, or longer if an individual starts at an entry level classification. Indeed, most employees require more than 60 months to progress from Electrician 3<sup>rd</sup> Class to Construction Electrician. Some hires, however, join the Company with advanced skill sets and training and may begin employment at a higher classification than Electrician 3<sup>rd</sup> Class. Progression to Construction Electrician may take less than 60 months for these individuals.

Training and progression is documented for each employee. Training is recorded when it impacts progression through classifications as noted in each department's progression plan. Documentation ensures that employees have been exposed to all facets of the required work for Service Company employees. Some technical training is supplied initially on the National Electric Safety Code. Code update classes are provided for those who choose to hold a state electrician's license. As indicated at the technical sessions, electric utilities are exempt from the code because the nature of the work does not align with public access buildings and designs for construction are issued by licensed professional engineers for utility work.

Many compliance and safety training sessions are offered by the Company. They include but are not limited to: Annual Employee Awareness Training, Lock-Out/Tag-Out, Asbestos Awareness, Job Briefing, HAZWOPPER, Commercial Driver's License, Hoisting & Rigging, Shoring and Trenching, Fall Protection, Switching & Tagging, Substation Work Area Protection, etc. No single classification requires all of the above referenced training, and some specialty classifications may require specific compliance and safety training not listed. This is true for the internal workforce and any direct hires working under Letters of Assent. The qualifications for any individual acquired through this process are checked prior to an assignment and while actually performing the task at hand. Safety awareness training is also provided to these individuals.

Contractors are held to the same high standards as the Company's internal employees. This market-acquired workforce is coordinated by the Service Company's Construction and Maintenance Services Department. A three step qualification process is managed by the Service Company's Supply Chain Management Department. An intensive pre-qualification stage requires review of completed projects, verification of vendor financials, and technical capabilities. Once admitted as a pre-bid participant, contract responses from bidders are carefully screened for conformance to pre-bid information and an analysis of their submittals is performed. This stage of the process includes a review of workers to be supplied by name with assurances of progression, training, and compliance to all applicable OSHA and internal safety requirements. Qualified electricians must have successfully completed an apprenticeship program similar to courses and training which internal employees take. Approved state or federally certified training programs may be substituted for or augment apprentice programs. Typically this training includes both classroom instruction and on-the-job

training, and would take no less than five years to complete. A typical curriculum may include 1,000 hours of classroom instruction and 10,000 hours of on-the-job training. Thus qualified, these electricians may perform assigned work on the Company's systems.

Once awarded work, vendor firms are assigned a company Field Construction Coordinator ("FCC"), who is charged with daily construction oversight. The FCC monitors the quantity and quality of work, and ensures that consistent adherence to all safety and health requirements are in place and active.

Contractors must work in accordance with the Company's published Contractor Safety Requirements (see attached). This document covers the administrative and technical safety requirements for working on overhead lines, underground systems, and substations. Safety and health requirements required to perform forestry and vegetation management work are also provided.

Distribution work, including overhead and underground line construction, repair and modifications, and operations and maintenance activities, are awarded and monitored in the same manner as noted above for substation and transmission line work. In-house distribution work forces are directed by Mass. Electric. Contractors receive their direction from the Construction and Maintenance Services Department.

Required training and testing for progression in the overhead lines, underground lines, and substation operations and maintenance departments are attached. The process for securing contractors for this work is exactly as noted previously for substation, transmission, and forestry vendors. Distribution contractors must also adhere to the attached Contractor Safety Requirements.

Prepared by or under the supervision of: Richard L. Francazio

NEW ENGLAND  
POWER SERVICE CO.



ELECTRICAL DEPARTMENT

PROGRESSION  
PLAN

134  
480 / 1000  
01218110

ELECTRICAL DEPARTMENT  
QUALIFICATION CHECK LIST FOR 3RD CLASS

NAME: \_\_\_\_\_

EMPLOYMENT DATE \_\_\_\_\_

CLASSIFICATION DATE \_\_\_\_\_

CONDUIT	APPR.	DATE
RIGID	_____	_____
PVC	_____	_____
EMT	_____	_____
CONDUCTOR		
SIZES	_____	_____
CABLE (TYPES)	_____	_____
INSULATION (TYPES)	_____	_____
TOOL DECLARATION SEE REQUIRED TOOL LIST ELECTRICIAN 3RD CLASS	_____	_____
DRIVER'S LICENSE	_____	

\_\_\_\_\_  
SIGNATURE OF SUPERVISOR

\_\_\_\_\_  
DATE

THIS CHECKLIST MUST BE COMPLETED BEFORE QUALIFYING FOR 3RD CLASS.

*[Signature]* 3/6/90  
RJD 3/6/90

MEMORANDUM

TO Electricians 3rd Class

DATE 01/26/89

FROM R. J. Domenico

Westborough

FILE 4449c

SUBJECT	REQUIRED HAND TOOLS
1. <u>Preparation of the work area</u>	1. <u>Hand saw</u> 2. <u>Hand plane</u> 3. <u>Hand chisel</u> 4. <u>Hand file</u> 5. <u>Hand sandpaper</u> 6. <u>Hand brush</u> 7. <u>Hand cloth</u>
2. <u>Assembly of the work piece</u>	1. <u>Hand saw</u> 2. <u>Hand plane</u> 3. <u>Hand chisel</u> 4. <u>Hand file</u> 5. <u>Hand sandpaper</u> 6. <u>Hand brush</u> 7. <u>Hand cloth</u>
3. <u>Finishing of the work piece</u>	1. <u>Hand saw</u> 2. <u>Hand plane</u> 3. <u>Hand chisel</u> 4. <u>Hand file</u> 5. <u>Hand sandpaper</u> 6. <u>Hand brush</u> 7. <u>Hand cloth</u>

This list of required hand tools should be considered as the minimum necessary to perform the duties of Electrician 3rd Class and is not intended to prevent an individual from bringing a reasonable assortment of additional tools to the job.

- |   |  |
|---|--|
| 1 | tool box with lock   |
| 1 | 6' wooden rule   |
| 1 | electrician's knife  |
| 1 | 8" side cutter pliers                                      |
| 2 | pair channel lock pliers                                   |
| 1 | 8" adjustable wrench                                       |
| 1 | 6" adjustable wrench                                       |
| 1 | set flat blade screwdrivers stub to 8"                     |
| 1 | set Philip No. screwdrivers stub to 6"                     |
| 1 | torpedo level  |
| 1 | hack saw frame   |
| 1 | ball peen hammer   |
| 1 | claw hammer  |
| 1 | center punch   |
| 1 | plumb bob  |
| 1 | adjustable square  |
| 1 | 1/2" drive socket set 3/8" up to 1"                        |
| 1 | set of combination (box & open end) wrenches 3/8" up to 1" |

4405c

RD 3/4/90

## TRAINING PROPOSAL

### 3RD CLASS

No formal training required for 3rd class.  
This level could easily be met by anyone who  
has worked 6 months in the electrical trade.

### 2ND CLASS

ELECTRICAL ASSEMBLIES

O.J.T.

ELECTRICAL SKILLS

O.J.T.

EQUIPMENT SKILLS

O.J.T.

Equipment requiring Class II license

Training  
Testing

In House  
Registry

HOISTING & RIGGING LICENSE

Training  
Testing

In House  
In House

TAGGING LIST

Training  
Testing

In House  
Safety Dept

SAFETY SUPERVISOR TRAINING COURSE

In House

### 1ST CLASS

System 1-Line Diagrams, Primary Construction  
Prints, Substations Structures, Test Equipment

O.J.T. &  
In House

*CFZ 3/1/90*

*RJD 3/6/90*

## CONSTRUCTION ELECTRICIAN

Familiarization of cable schedules & wiring  
schematics per NEES standards & methods

In House

TEST EQUIPMENT

O.J.T.

HIGH VOLTAGE ASSEMBLIES & CABLE TECHNIQUES

In House

WORKING AT HEIGHTS

O.J.T.

ELECTRICIAN LICENSE - 300 hour approved course  
by other (State approved Schools)

State Board  
of  
Examiners

Operation of tools & equipment typical to utility  
maintenance and construction projects. For  
example, oil handling and processing, transformer  
installations and SF6 gas processing

O.J.T.  
or  
In House

## SECONDARY WIRING COURSE

Training  
Testing

In House  
In House

## SWITCHBOARD WIREMAN

Skills necessary to effectively communicate with  
dispatchers, engineers, designers, relay and C.C.  
techs to set up, wire, and complete projects.

In House

*RF*  
*3/6/90*  
*RJD 3/6/90*

CLASSIFICATION GUIDELINE

CLASSIFICATION: ELECTRICIAN 3RD CLASS

DEPARTMENT: ELECTRICAL

PRECEDING CLASSIFICATION: ENTRY LEVEL

NEXT POSSIBLE CLASSIFICATION(S): ELECTRICIAN 2ND CLASS

MAJOR DUTIES & REQUIREMENTS OF THIS CLASSIFICATION:

MECHANICAL AND ELECTRICAL DUTIES INCLUDE ASSEMBLY OF CONDUIT AND "RUNNING" WIRE, PIPE THREADING, ASSIST IN RIGGING, AND GENERAL HOUSEKEEPING DUTIES.\* EMPLOYEE IS REQUIRED TO FURNISH HIS OWN TOOLS. OTHER RELATED DUTIES WILL BE ASSIGNED. MUST POSSESS VALID DRIVERS LICENSE FROM HIS STATE OF RESIDENCE. MUST BE NUCLEAR QUALIFIED.

TRAINING/TESTING REQUIREMENTS:

PERFORMANCE APPRAISAL WILL FORM BASIS FOR PROGRESSION FOR THIS CLASSIFICATION

ANY EMPLOYEE RECEIVING AN UNSATISFACTORY PERFORMANCE APPRAISAL WILL BE ASSIGNED AND APPRAISED BY TWO (2) OTHER SUPERVISORS WITHIN THE NEXT APPRAISAL PERIOD.

POSSIBLE MINIMUM REQUIRED DURATION IN CLASSIFICATION:

\*Required hand tools as per memo dated 1/26/89.

*RR*  
*3/6/90*  
*RDS 3/6/90*

CLASSIFICATION GUIDELINE

CLASSIFICATION: ELECTRICIAN 2ND CLASS

DEPARTMENT: ELECTRICAL

PRECEDING CLASSIFICATION: ELECTRICIAN 3RD CLASS

NEXT POSSIBLE CLASSIFICATION(S): ELECTRICIAN 1ST CLASS

MAJOR DUTIES & REQUIREMENTS OF THIS CLASSIFICATION:

EMPLOYEE'S DUTIES INCLUDE THE ASSEMBLY AND TESTING OF ELECTRICAL CIRCUITS.

- A. MEET ALL REQUIREMENTS OF PRIOR CLASSIFICATION
- B. MUST BE ON THE RED TAG LIST
- C. HAVE A SATISFACTORY ABSENTEE RECORD
- D. MUST WORK SAFELY AND EFFICIENTLY IN A WORKMAN LIKE MANNER
- E. MUST BE ABLE TO PERFORM VARIOUS TYPES OF ELECTRICAL MAINTENANCE AND CONSTRUCTION TYPE DUTIES IN A PROFESSIONAL MANNER
- \* F. SATISFACTORY EMPLOYEE APPRAISAL FOR PAST YEAR

TRAINING/TESTING REQUIREMENTS:

A WRITTEN AND PRACTICAL TEST WILL BE REQUIRED FOR PROGRESSION TO THIS CLASSIFICATION. THE WRITTEN TEST WILL CENTER ON BASIC ELECTRICAL THEORY AND DEPARTMENT WORK PRACTICES. I.C.S., COURSES AND COMPARABLE CLASSROOM ACTIVITIES WOULD BE BENEFICIAL PRIOR TO TESTING. THE PRACTICAL TEST CENTER ON JOB KNOWLEDGE AND MATERIAL AND EQUIPMENT KNOWLEDGE. A PASSING GRADE OF 70% WILL BE REQUIRED ON BOTH THE WRITTEN AND PRACTICAL TEST. NO TESTING WILL BE DONE ON SUBJECTS THAT HAVE NOT BEEN SUFFICIENTLY COVERED IN THE TRAINING PROGRAM.

POSSIBLE MINIMUM REQUIRED DURATION IN CLASSIFICATION:

ONE (1) YEAR

- \* ANY EMPLOYEE RECEIVING AN UNSATISFACTORY PERFORMANCE APPRAISAL WILL BE ASSIGNED AND APPRAISED BY TWO (2) OTHER SUPERVISORS WITHIN THE NEXT APPRAISAL PERIOD.

*Handwritten:*  
152 3/6/90

ELECTRICAL DEPARTMENT  
QUALIFICATION CHECK LIST FOR 2ND CLASS

NAME: \_\_\_\_\_

EMPLOYMENT DATE \_\_\_\_\_

CLASSIFICATION DATE \_\_\_\_\_

ELECTRICAL ASSEMBLIES	APPR.	DATE
CABLE TRAY	_____	_____
CABLING	_____	_____
TERMINATIONS (MECHANICAL & COMPRESSIONS)	_____	_____
STRUCTURES	_____	_____
ELECTRICAL SKILLS		
GENERAL	_____	_____
GROUNDING	_____	_____
SERVICES	_____	_____
TESTING (LINE)	_____	_____
EQUIPMENT SKILLS		
BOOM TRUCK	_____	_____
BUCKET TRUCK	_____	_____
DITCH WITCH	_____	_____
MARK LIFT	_____	_____
COMPRESSION TOOLS	_____	_____

\_\_\_\_\_  
SIGNATURE OF SUPERVISOR

\_\_\_\_\_  
DATE

THIS CHECKLIST MUST BE COMPLETED BEFORE QUALIFYING FOR 2ND CLASS

*W.P. 3/4/90*  
*PSD 3/6/90*

CLASSIFICATION GUIDELINE

CLASSIFICATION: ELECTRICIAN 1ST CLASS

DEPARTMENT: ELECTRICAL

PRECEDING CLASSIFICATION: ELECTRICIAN 2ND CLASS

NEXT POSSIBLE CLASSIFICATION(S): CONSTRUCTION ELECTRICIAN

MAJOR DUTIES & REQUIREMENTS OF THIS CLASSIFICATION:

EMPLOYEE IS REQUIRED TO USE AND ANALYZE THE RESULTS OF METERS AND OTHER TESTING EQUIPMENT. OTHER RELATED DUTIES WILL BE ASSIGNED SUCH AS THE OPERATION OF CONSTRUCTION EQUIPMENT NEEDED TO INSTALL AND MAINTAIN ELECTRICAL EQUIPMENT. THE ELECTRICIAN 1ST CLASS WILL BE REQUIRED TO HAVE A BASIC UNDERSTANDING OF THE NATIONAL ELECTRICAL CODE.

- A. MEET ALL REQUIREMENTS OF PRIOR CLASSIFICATIONS
- B. MUST HAVE A GOOD UNDERSTANDING OF MAINTENANCE AND CONSTRUCTION WORK IN SUBSTATIONS AND POWER PLANTS
- C. HAVE A GOOD UNDERSTANDING OF SYSTEM ONE LINE DIAGRAM
- D. HAVE A GOOD UNDERSTANDING OF PRIMARY CONSTRUCTION BLUEPRINTS
- E. MUST HAVE SKILLS NECESSARY TO TAG OUT SYSTEMS OR CIRCUITS
- \* F. SATISFACTORY PERFORMANCE APPRAISAL FOR PAST YEAR

TRAINING/TESTING REQUIREMENTS:

WRITTEN AND PRACTICAL TEST TO BE ADMINISTERED BY THE COMPANY. NO TESTING WILL BE DONE ON SUBJECTS THAT HAVE NOT BEEN SUFFICIENTLY COVERED IN THE TRAINING PROGRAM.

POSSIBLE MINIMUM REQUIRED DURATION IN CLASSIFICATION:

ONE (1) YEAR

- \* ANY EMPLOYEE RECEIVING AN UNSATISFACTORY PERFORMANCE APPRAISAL WILL BE ASSIGNED AND APPRAISED BY TWO (2) OTHER SUPERVISORS WITHIN THE NEXT APPRAISAL PERIOD.

*Handwritten signature and date:*  
5/11/92  
RDE 5/6/92

ELECTRICAL DEPARTMENT  
QUALIFICATION CHECK LIST FOR 1ST CLASS

NAME: \_\_\_\_\_

EMPLOYMENT DATE \_\_\_\_\_

CLASSIFICATION DATE \_\_\_\_\_

	APPR.	DATE
SYSTEM 1-LINE DIAGRAMS	_____	_____
PRIMARY CONSTRUCTION PRINTS	_____	_____
SUBSTATION STRUCTURE WORK	_____	_____
TEST EQUIPMENT		
VOLTMETER	_____	_____
AMMETER	_____	_____
OHMMETER	_____	_____
MICRO OHMMETER	_____	_____
MEGGER	_____	_____
GAS DETECTORS	_____	_____
TRANSFORMER TURNS RATIO	_____	_____
SAFETY SUPERVISOR COURSE	_____	_____
RED TAG LIST	_____	_____

\_\_\_\_\_  
SIGNATURE OF SUPERVISOR

\_\_\_\_\_  
DATE

THIS CHECKLIST MUST BE COMPLETED BEFORE QUALIFYING FOR 1ST CLASS.

*[Handwritten signature]*  
*1020 3/6/8.*

CLASSIFICATION GUIDELINE

CLASSIFICATION: CONSTRUCTION ELECTRICIAN

DEPARTMENT: ELECTRICAL

PRECEDING CLASSIFICATION: ELECTRICIAN 1ST CLASS

NEXT POSSIBLE CLASSIFICATION(S): SWITCHBOARD WIREMAN/WORKING FOREMAN

MAJOR DUTIES & REQUIREMENTS OF THIS CLASSIFICATION:

EMPLOYEE MUST BE ABLE TO PERFORM ELECTRICAL AND MECHANICAL CONSTRUCTION DUTIES PERTINENT TO SUBSTATION CONSTRUCTION. THIS INCLUDES INTERPERTATION OF DRAWINGS AND SCHEMATICS. INDIVIDUAL MUST BE ABLE TO CONSTRUCT TROUBLE SHOOT AND REPAIR EXTRA HIGH VOLTAGE ASSEMBLIES. THIS REQUIRES THE ABILITY TO CLIMB STRUCTURES AND POLES, OPERATE EQUIPMENT USED FOR TYPICAL SUBSTATION MAINTENANCE AND CONSTRUCTION PROJECTS.

- A. MEET ALL REQUIREMENTS OF PRIOR CLASSIFICATIONS
- B. MUST HAVE A JOURNEYMENS LICENSE FROM A STATE WITHIN OUR SERVICE AREA
- C. HAVE A GOOD OVERALL UNDERSTANDING OF SUBSTATION AND POWER PLANT OPERATIONS.
- D. BE ABLE TO READ AND UNDERSTAND A SYSTEM ONE LINE DIAGRAM
- E. HAVE THE ABILITY TO READ AND UNDERSTAND PRIMARY CONSTRUCTION BLUEPRINTS
- F. HAVE THE SKILLS REQUIRED TO PERFORM ELECTRICAL CONSTRUCTION PRIMARY WORK IN A SAFE AND EFFICIENT WORKMAN LIKE MANNER
- \* G. SATISFACTORY PERFORMANCE APPRAISAL FOR PAST TWO (2) YEARS

TRAINING/TESTING REQUIREMENTS:

WRITTEN AND PRACTICAL TEST TO BE ADMINISTERED BY THE APPROPRIATE STATE BOARD OF EXAMINERS

POSSIBLE MINIMUM REQUIRED DURATION IN CLASSIFICATION:

TWO (2) YEARS

- \* ANY EMPLOYEE RECEIVING AN UNSATISFACTORY PERFORMANCE APPRAISAL WILL BE ASSIGNED AND APPRAISED BY TWO (2) OTHER SUPERVISORS WITHIN THE NEXT APPRAISAL PERIOD.

*[Handwritten signature]* 3/14/90  
*[Handwritten signature]* 3/16/90

ELECTRICAL DEPARTMENT  
QUALIFICATION CHECK LIST FOR CONSTRUCTION ELECTRICIAN

NAME: \_\_\_\_\_

EMPLOYMENT DATE \_\_\_\_\_

CLASSIFICATION DATE \_\_\_\_\_

	APPR.	DATE
CABLE SCHEDULES	_____	_____
WIRING SCHEMATICS	_____	_____
TEST EQUIPMENT	_____	_____
HIGH VOLTAGE ASSEMBLIES & CABLES	_____	_____
ABILITY TO WORK AT HEIGHTS i.e. platforms and structures	_____	_____
ABILITY TO OPERATE ALL TOOLS AND EQUIPMENT WHICH ARE STANDARD TO TYPICAL UTILITY MAINTENANCE AND CONSTRUCTION PROJECTS.	_____	_____
OIL HANDLING EQUIPMENT	_____	_____
SF <sup>6</sup> HANDLING EQUIPMENT	_____	_____
STATE ELECTRICIANS LICENSE	_____	_____
_____ SIGNATURE OF SUPERVISOR	_____ DATE	_____

THIS CHECKLIST MUST BE COMPLETED BEFORE QUALIFYING FOR CONSTRUCTION ELECTRICIAN.

*[Handwritten Signature]* 2/5/77  
*[Handwritten Signature]* 3/6/80

CLASSIFICATION GUIDELINE

CLASSIFICATION: SWITCHBOARD WIREMAN

DEPARTMENT: ELECTRICAL

PRECEDING CLASSIFICATION: CONSTRUCTION ELECTRICIAN

NEXT POSSIBLE CLASSIFICATION(S): WORKING FOREMAN

MAJOR DUTIES & REQUIREMENTS OF THIS CLASSIFICATION:

EMPLOYEE IN THIS CLASSIFICATION IS REQUIRED TO WORK FROM DRAWINGS AND SCHEMATICS TO WIRING SWITCHBOARDS, BREAKERS, ETC. INDIVIDUAL MUST BE ABLE TO CUT INTO ENERGIZED SECONDARY CIRCUITS AND PERFORM E.H.V. REPAIR WORK

- A. MEET ALL REQUIREMENTS OF PRIOR CLASSIFICATIONS
- B. BE ABLE TO PERFORM FUNCTIONAL TESTING OF CIRCUITS AND SYSTEMS
- C. HAVE GOOD COMMUNICATION SKILLS
- D. HAVE THE ABILITY TO COORDINATE WITH OTHER DEPARTMENTS FOR SCHEDULING OF SYSTEM CUTOVERS
- \* E. SATISFACTORY PERFORMANCE APPRAISAL FOR PAST 1 1-2 YEARS

TRAINING/TESTING REQUIREMENTS:

A WRITTEN AND PRACTICAL TEST COVERING ADVANCED ELECTRICAL THEORY AND DRAWING INTERPERTATION WILL BE REQUIRED PRIOR TO PROGRESSION. A WRITTEN TEST WILL COVER SWITCHBOARD WIRING CIRCUIT WIRING AND TESTING, RELAY AND METERING FUNDAMENTALS, SCHEMATIC AND ELEMENTARY DIAGRAMS WHICH PERTAIN TO SYSTEM MAINTENANCE AND CONSTRUCTION WORK. THE PRACTICAL TEST WILL COVER FUNCTIONAL TESTING, TROUBLE SHOOTING AND WIRING TECHNIQUES. A PASSING GRADE OF 70% WILL BE REQUIRED ON BOTH THE WRITTEN AND PRACTICAL TEST. NO TESTING WILL BE DONE ON SUBJECTS THAT HAVE NOT BEEN SUFFICIENTLY COVERED IN THE TRAINING PROGRAM

POSSIBLE MINIMUM REQUIRED DURATION IN CLASSIFICATION:

ONE AND ONE HALF (1 1/2) YEARS AS A TEMPORARY SWITCHBOARD WIREMAN

- \* ANY EMPLOYEE RECEIVING AN UNSATIDFACTORY PERFORMANCE APPRAISAL WILL BE ASSIGNED AND APPRAISED BY TWO (2) OTHER SUPERVISORS WITHIN THE NEXT APPRAISAL PERIOD.

*Handwritten:* 3/4/90  
3/6/90

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## FOREWORD

This document, "Contractor Safety Requirements", represents the current contractor safety requirements that are unique to operations at National Grid. This document does not reference actions that are required by OSHA, other laws, rules, or regulations. These are requirements that should be understood by the contractor and contractor compliance with all applicable federal, state and local laws, rules, and regulations is expected by National Grid as a contractual condition.

Please direct any questions regarding this document to the Corporate Safety Group, Safety and Health Services.

This document will be updated as necessary to reflect changes in National Grid safety policies and procedures.

### Record of Change

#### Date of Review/Revision:

Revision	Date	Description
1	08/5/2004	Initial
2	3/2/2005	Additions

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## 1.0 CONTRACTOR SAFETY AT NATIONAL GRID

### 1.1 Introduction

Safety performance is a prime consideration in the selection of contractors. National Grid USA will stipulate safety and health performance requirements and responsibilities in our contracts and purchase orders and will hold the contractor accountable for meeting the contractual requirements.

This document, "Contractor Safety Requirements", is updated periodically to communicate all aspects of National Grid contractor safety to bidders and current contractors.

National Grid's goal is to establish a long-term working relationship with contractors who share the same safety values and demonstrate those values through their work performance.

Contractor safety at National Grid involves three broad areas:

- (1) The Contractor Selection Process (Procurement)
- (2) Safety Communication
- (3) Safety Compliance

#### (1) ***Contractor Procurement***

Contractor safety begins with the selection of contractors who have demonstrated a good safety record.

#### (2) ***Safety Communication***

Safety communication covers all the avenues and forums in which National Grid and the contractor communicates safety. Communication begins early in the bidding phase and is on-going as an integral part of the contractor-customer relationship. The goal is to ensure clarity and to limit misunderstandings.

#### (3) ***Safety Compliance***

Safety compliance is the process of ensuring that the provisions of the contract are being followed. National Grid will assign a Field Construction Coordinator or other designated individual to provide guidance and oversight. The contractor is responsible for their employees and subcontractors and shall be held accountable for ensuring compliance with all applicable safety rules while working on National Grid property.

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## 1.2 Risk Ranking of Work

1. At the beginning of any project, National Grid will conduct a risk assessment for each anticipated work activity of a contracted service. National Grid will categorize these activities as low, medium or high risk. Risk refers to the chance of injury, property damage, or adverse public impact should the contractor deviate from the prescribed safety measures.
2. **Activities that are designated as “high risk” means that death can result if safety measures are not followed.** In general, any work related to electrical transmission and distribution, and gas operations shall be ranked by National Grid as high risk.
3. The designation high risk, medium risk, or low risk, refers only to the inherent risk associated with the work activity and is not an opinion on the ability of a contractor to work safely.
4. The purchasing agent will notify the bidder/contractor at the beginning of the procurement process if their contracted service has been ranked as high risk.

## 1.3 Bidder Information Request – High Risk Work

1. The purchasing agent will send all contractors bidding work designated as high risk a “Bidder Information Request” form. This is the first step in establishing a working relationship with National Grid. For contractors already on the National Grid bid list, Procurement will periodically request updated information.
2. The information that the bidder provides serves as the basis for assessing safety qualification. For this reason, it is important that this form is approached in a candid and thorough manner. National Grid will review the submitted information. Any effort to avoid complete disclosure will disqualify the bidder from bidding work at National Grid.

## 1.4 Safety Compliance

1. National Grid evaluates contractor compliance by conducting routine site visits, safety observation tours, and attending periodic contractor safety meetings.
2. If a safety violation is observed by a National Grid representative, the violation will be discussed with the contractor at the time of discovery.

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3. The contractor must immediately establish corrective actions and implement measures to prevent a recurrence.
4. Individual contractor personnel who habitually violate safety rules should be identified, and the contractor should remove the individual(s) from the project.
5. If a contractor is observed to be operating in a manner that creates an imminent danger to persons or property, it is the responsibility of any National Grid employee observing the hazard to stop the job or that portion of the job impacted until the issue has been resolved to the satisfaction of the Field Construction Coordinator or Safety representative.
6. Contracts/POs shall require the contractor to immediately forward any citations or notices incurred on the project upon receipt to the appropriate company representative.
7. Willful and repeat violations of safety requirements by the contractor may be considered a breach of the contract and reason for contract termination.
8. If the contractor's overall safety performance is viewed as being unsatisfactory or noncompliant with contract provisions, and if the contractor is unwilling to demonstrate satisfactory program improvement, the contractor may be removed from the project as may be provided for in the contract.
9. National Grid documents safety compliance by completing a "Contractor Performance Evaluation". This documents both good and bad safety performance and this feedback will be used in the decision process for awarding future contracts.

## **2.0 GENERAL SAFETY REQUIREMENTS**

### **2.1 Introduction**

1. All contractors are required to comply with the requirements of the Occupational Safety and Health Administration (OSHA), all other applicable federal, state, and local laws, ordinances, regulations, and other project and site-specific permits.

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2. This document represents policies and safety-related work methods that are unique to National Grid and that may go beyond OSHA rules. Contractors must follow these requirements as well as their own rules that meet or exceed OSHA and other regulatory requirements.
3. In cases where there is more than one method of compliance with a given safety rule or regulation, the contractor may deviate from National Grid practices if they can demonstrate to National Grid that the alternative practice provides an equal or greater margin of safety.
4. National Grid will provide more detailed information and guidance regarding specific procedures prior to commencement of work.

## **2.2 Applicability**

This document applies to all contractors; however most of the requirements are directed to contractors who perform work that is related to National Grid's core business functions: electrical transmission and distribution, and gas operations.

## **3.0 ADMINISTRATIVE SAFETY REQUIREMENTS**

### **3.1 Pre-Bid Meeting**

Applies to: All contractors, as needed.

The pre-bid meeting is coordinated by National Grid Procurement to provide bidders with an opportunity to acquaint themselves with contractual requirements and specific safety issues concerning the project, including company-specific safety rules and known site conditions. This meeting may not be necessary for all projects.

### **3.2 Project Safety Plan**

Applies to: Contracted services ranked as high risk.

1. Contractors who perform high risk-ranked services shall submit a project-specific safety plan prior to the pre-construction meeting.
2. The contents of this document, "Contractor Safety Requirements", and this section provide guidance to develop the safety plan.

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3. At a minimum, the safety plan shall include the following elements:

- A. Roles and responsibilities
- B. Scope of work
- C. Task and Hazard Identification and risk assessment of the hazards
- D. Hazard mitigation/control procedures and work methods
- E. Incident analysis and reporting
- F. Compliance and monitoring

**A. Roles and Responsibilities**

The plan shall identify who will be responsible for the project oversight and their qualifications. For example, if the work requires excavation, there must be someone on-site who would be qualified as a competent person.

For multi-employer work-sites, the general contractor is responsible for all their employees and subcontractors. The safety plan shall clearly state this responsibility.

**B. Scope of Work**

Briefly state the scope of work as provided by National Grid. The plan must specifically address the project or services requested by National Grid. Therefore, these plans should be short and-to the-point.

**C. Task and Hazard Identification and Risk Assessment**

The contractor shall identify all significant tasks and the anticipated hazards. National Grid calls this process a risk assessment.

The contractor's cost to provide adequate safety measures and to comply with National Grid requirements must be considered and budgeted in the bid/proposal.

**D. Hazard Mitigation Procedures and Work Methods**

For each hazard, the contractor shall specify measures that will be taken to mitigate these hazards.

A table format is the simplest way to organize and present the task, hazard, and mitigation steps. For example:

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<b>Location:</b>	Substation Yard	
<b>Task</b>	<b>Hazard</b>	<b>Mitigation Steps</b>
Material Handling	Contact with overhead energized lines/equipment	Off-load in the clear and have a safety observer present

#### **E. Incident Analysis and Reporting**

Follow the requirements referenced in this document.

#### **F. Compliance Monitoring**

Explain how you will ensure that both your employees and subcontractors will achieve safety compliance.

### **3.3 Contractor Orientation**

Applies to: All contractors, as needed.

1. Contractor orientation is intended to serve as a resource in order to provide the contractor with the tools necessary to educate their employees and subcontractors. The session is not intended to train the contractor management, their employees, or subcontractors.
2. The extent and content of the orientation session shall be commensurate with the scope and type of the contractor's activities.
3. The contractor shall agree to provide management representation at the orientation session.
4. After the completion of the orientation session, a Contractor Management Official shall certify in writing that: (1) the contractor has been informed of National Grid safety requirements; (2) that employees and subcontractors have the appropriate qualifications to perform the work, and; (3) the contractor agrees to comply with all applicable safety requirements. The certification shall be in the form of a "Letter of Assurance", printed on the contractor's letterhead, signed by a principal of the contractor, and delivered to your company's National Grid contact.

### **3.4 Worker Qualification Assurance**

Applies to: All contractors, as needed.

1. In order to meet National Grid safety requirements, the contractor must describe how workers, including subcontractors, are qualified.

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The contractor must supply information concerning the types of skills assessments performed, training programs and how they ensure that employees demonstrate competencies.

2. The Contractor Management Official shall certify the contractor has been informed of National Grid safety requirements; that employees and subcontractors have the appropriate qualifications to perform the work, and; that the contractor agrees to comply with all applicable safety requirements.
3. The bidder shall supply the backgrounds and qualifications for all management personnel through resumes or other documents. National Grid shall interview and approve management personnel if considered necessary.
4. Contractors bidding on new work provide this information to the National Grid purchasing agent via the "Bidder Information Request" form.

### **3.5 Pre-Construction Meeting**

Applies to: High risk ranked projects or activities.

1. National Grid holds a pre-construction or project kickoff meeting with the contractors prior to the start of a high risk-ranked project.
2. The contractor's Project Safety Plan will be discussed at this meeting.
3. These hazard mitigation measures shall be reviewed and work shall not commence until these hazards have been adequately addressed. The Field Construction Coordinator, or other user representative, will discuss with the contractor the methods by which compliance will be achieved with National Grid safety requirements.
4. An Emergency Call List should be exchanged with the contractor. This list must contain 24-hour contact information for key contractor and project personnel, including Field Construction Coordinators and Safety & Health Specialists. This list should be distributed to all concerned, as determined by the project team, prior to the start of work.
5. For routine maintenance services, a review of associated safety issues and specific facility issues, restrictions or practices, such as evacuation procedures, must be discussed with the contractor upon initial hiring. Any changes in the facility that may affect the safety of contractor or National Grid employees or third parties must be communicated immediately.

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### 3.6 Safety Meetings and Job Safety Briefs

Applies to: All contractors, as needed.

1. The contractor shall have regular safety meetings with their employees and subcontractors.
2. Each crew shall conduct job safety briefs prior to each day's work; when there are changes to the work order or plan, and when a new worker joins the crew additional briefs are required.
3. Each worker must have the opportunity to voice concern. The work cannot begin until each worker signs off on the job brief stating that they have discussed the work and agree with the plan.
4. Both safety meetings and job briefs shall be documented in writing. Written job briefs shall be available at the job site for inspection and retained for 30 days after the job is completed.

### 3.7 Incident Analysis

Applies to: All contractors (regardless of risk ranking).

1. The contractor supervisor shall report any work-related incidents involving injury or illness to employees, the public or property damage to the contractor's or National Grid's equipment to their National Grid point of contact. The first priority is to ensure that the injured receive medical treatment.
2. The contractor's National Grid point of contact will explain these reporting requirements in more detail prior to commencement of work. This point of contact refers to either a National Grid department, work group, supervisor, engineer or Field Construction Coordinator.
3. An incident is defined as an unplanned event that has a human component, and results in, or could potentially result in, at least one of the following outcomes: (1) harm to people; (2) damage to property; (3) adverse public impact.
4. There are four categories of incidents.
  1. **Injury** – incidents that cause harm to people;
  2. **Property Damage** – incidents that cause damage to property;

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3. **Adverse Public Impact** – incidents that disrupt service to the public or result in adverse public reaction;
4. **Near-Miss** – an incident which had the potential under different circumstances to result in an injury.

5. A Hazardous Condition is defined as:

Significant hazard      A condition that requires others to take actions to rectify and requires further investigation as to how the situation came to occur.

### Incident Response Steps

In the event of an incident, the contractor shall provide details of the incident to their National Grid point of contact following the steps below.

1. Contractor supervisor collects basic information about the incident from the employee or witnesses:
  - a. What happened?
  - b. Who and how many people were injured?
  - c. What treatment was administered?
  - d. What was the nature and seriousness of the injury?
  - e. Where did the incident occur?
  - f. When did the incident occur (date, time of day)?
  - g. Were there any witnesses?
2. The National Grid point of contact calls the One-Call phone number (1-866-322-5594) to report the incident.
3. Contractor shall conduct an investigation and provide an initial written report if directed to do so by National Grid.
4. The contractor will then conduct an investigation that will identify contributing factors relating to the incident and the corrective actions that will be taken to prevent reoccurrence. The results of the investigation shall be described in a report prepared by the contractor and provided to National Grid. The contractor shall use National Grid Incident Reporting forms which will be provided by their National Grid point of contact.
5. Contractor vehicle accidents occurring during the performance of work will also be investigated and reported to their National Grid point of contact.

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### **Other Reporting**

National Grid may periodically request the following annualized data for all work activities limited to National Grid operations:

- Lost Time Incident (LTI) rate for workers
- Restricted Work rate
- OSHA Recordable Incident (ORI) rate

## **4.0 TECHNICAL SAFETY REQUIREMENTS**

### **4.1 Personal Protective Equipment (PPE) Requirements – General**

Applies to: All contractors (regardless of risk ranking).

1. Basic PPE attire at construction sites and other similar work zones include at a minimum: hard hat; safety shoes, and safety glasses.
2. The contractor shall ensure that their employees and subcontractors use protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where such employee's feet are exposed to electrical hazards. Electrical Hazard (EH) rated footwear is required when working on or around electrical equipment over 50 volts, or in an area of expected downed wires. This requirement is based on OSHA 1910.136.
3. Guidance for additional PPE is referenced in other sections of this document.

### **4.2 Flame Retardant Clothing Requirements**

Applies to: All contractors, as needed.

1. Flame retardant (FR) clothing shall be worn when personnel work on energized equipment/lines or when distance and position will expose the worker to electric arc or flame hazards.
2. FR clothing shall be worn as the outermost layer of clothing.
3. FR clothing shall be worn when workers measure voltages or test or ground electrical equipment or lines.
4. FR clothing shall be worn when work requires the use of rubber protective equipment or the use of insulated live line tools.

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5. FR clothing shall be worn when workers control/operate electrical equipment over 50 volts at the device location or are within 10 feet of equipment which is being physically operated by another worker.
6. FR clothing shall be worn where a hazard identification sign is posted.
7. Contractors shall wear the appropriate FR clothing when working within 10 feet of energized equipment. For substations, visitors are not required to wear FR clothing unless they are engaged in electrical work. Your National Grid contact will be able to determine whether FR clothing will be required based on the specific contractor task.

#### **4.3 Rubber Gloves and Sleeves**

Applies to: All contractors, as needed.

1. Rubber glove use is required for work on all electrical apparatus at 50 volts or greater. Class 0 gloves are required for exposures up to 1000 volts. Class 2 gloves are required for voltages between 1000 to 15,000 volts. Rubber glove exceptions for specific jobs are permitted only with the written approval of the local National Grid Operations Manager.
2. Rubber sleeves must be worn where work is conducted within the minimum approach distances of electrical apparatus that is not dead and grounded.
3. For voltages 23 kV and above, workers can use specialized equipment or work practices as long as these workers have been appropriately trained and qualified.
4. National Grid may request a letter of assurance from the contractor.

#### **4.4 Isolation of Energized Apparatus**

Applies to: All contractors, as needed.

1. Non-Reclosing Criteria and Live-Line Maintenance and Construction

The appropriate interrupting devices (breakers, reclosers, circuit switches, etc.) will be placed on NON-RECLOSING in accordance with National Grid tagging procedures.

2. Tagging Out Lines or Apparatus

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The Field Construction Coordinator (FCC) or other designated representative shall coordinate all switching and tagging prior to main line work. The contractor shall follow the appropriate National Grid switching and tagging procedure.

### 3. Grounding

When National Grid switches out lines or apparatus, any grounds that may be installed shall only be considered a visual reference, and shall not be considered a means to protect the contractor's employees. The contractor is responsible to install their personal grounds, in addition to National Grid's. National Grid will provide guidance on the minimum size of the grounds to be used based on circuit available fault current.

## 4.5 Appointment of a Safety Observer

Applies to: All contractors, as needed.

1. If work is being performed where there is a potential for persons or equipment to come in contact with energized equipment, a Safety Observer will be appointed by the contractor to aid in protecting employees and others from hazards. The Safety Observer will be a "Qualified Electrical Worker" with the training and experience specified in OSHA regulations, specifically the "Electric Power Generation, Transmission and Distribution Standard" 29 CFR 1910.269.
2. The Safety Observer will be appointed while positioning trucks, cranes or other equipment and where precise placement is required to avoid contact with or damage to existing equipment or circuits; while moving loads overhead that may come within OSHA clearance requirements; or at other times where assistance is needed to help direct specific tasks for the protection of personnel or property.

## 4.6 Work Zone Traffic Control

1. If work activity is on or near a road, the contractor and their subcontractors will comply with all applicable parts of the most current US Department of Transportation's Manual on Uniform Traffic Control Devices (MUTCD).
2. If working in areas covered by state permits issued to National Grid, contractors are required to comply with the provisions (work practices and notifications) of the permit language.

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#### **4.7 Qualified Electrical Workers**

Applies to: Electrical Projects / Activities

1. National Grid expects that electrical contractor employees will already be electrically-qualified as required by OSHA in 29 CFR 1910.269.
2. OSHA defines a qualified electrical worker or “qualified employee” as a person knowledgeable in the construction and operation of the electrical power generation, transmission and distribution equipment involved and the associated hazards. According to 1910.269(a)(2)(ii), a qualified employee must be trained and competent in:
  - The skills and techniques necessary to distinguish exposed live parts of electrical equipment;
  - The skills and techniques necessary to determine the nominal voltage of exposed live parts;
  - The minimum approach distances specified in 1910.269 corresponding to the voltages to which the qualified employee will be exposed, and;
  - The proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment.
3. Until these qualified employees have demonstrated proficiency in the work practices involved, they are considered to be employees undergoing on-the-job training and must be under the direct supervision of a qualified person at all times. According to the definition of a “qualified employee”, the employee also must have demonstrated an ability to perform work safely at his or her level of training.
4. National Grid requires contractors with electrically qualified employees to provide documentation on how they qualify their workers.

#### **4.8 Qualifying Non-Electrical Workers**

Applies to: All contractors, as needed.

##### Qualifying non-electrical workers to work near energized lines and equipment

1. The contractor must provide orientation for non-electrical workers for the purpose of entering and working within restricted areas such as a substation. This is a critical component of contractor orientation for all non-electrical contractors who will be working near energized lines and equipment (For example, civil contractors).

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2. The information provided to these workers must meet the requirements of paragraph 1910.269(a)(2)(ii). However, the orientation and training would not be as comprehensive as the training normally provided to a qualified electrical worker.

They must know:

- What is safe to touch and what is not safe to touch in the specific areas they will be entering;
  - The maximum voltage of the area;
  - The minimum approach distances for the maximum voltage within the area;
  - Proper use of protective equipment that will be used to provide protection for them and in the work practices necessary for performing their specific work assignments within the area.
3. Until these workers have demonstrated proficiency in the work practices involved, they are considered to be employees undergoing on-the-job training and must be under the direct supervision of a qualified person at all times. According to the definition of a “qualified employee”, the employee also must have demonstrated an ability to perform work safely at his or her level of training. It is expected that an orientation familiarizing the employee with the safety fundamentals above will be conducted before the worker is allowed to enter a restricted area.

## **5.0 OVERHEAD LINE WORK**

Applies to: All contractors, as needed.

In addition to the other requirements referenced in this document, this section covers requirements that are specific to overhead line work.

### **5.1 PPE Requirements**

Applies to: All contractors, as needed.

All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0. In addition, contractors will follow ground-to-ground and cradle-to-cradle use of rubber gloves while carrying out work on energized overhead lines.

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<b>Contractor Safety Requirements</b>	Date:	04/01/05

## 5.2 Fall Protection

Applies to: All contractors, as needed.

All contractors performing non-emergency work must utilize 100% fall protection equipment and techniques for wood pole climbing in accordance with National Grid guidelines by August 1, 2005.

## 5.3 Pole/Structure Inspection

Applies to: All contractors, as needed.

1. Contractor shall ascertain the structural integrity of the pole or other structure prior to installation, removal, or repair of equipment on the structure.
2. When work is to be performed on a wood pole, it is important to determine the condition of the pole before it is climbed. The weight of the employee, the weight of equipment being installed, and other working stresses (such as the removal or re-tensioning of conductors) can lead to the failure of a defective pole or one that is not designed to handle the additional stresses. For these reasons, it is essential that an inspection and test of the condition of a wood pole be performed before it is climbed.
3. If the pole is found to be unsafe to climb or to work from, it must be secured so that it does not fail while an employee is on it. The pole can be secured by a line truck boom, by ropes or guys, or by lashing a new pole alongside it. [29 CFR 1910.269(q)]

## 6.0 UNDERGROUND OPERATIONS WORK

Applies to: All contractors, as needed.

In addition to the other requirements referenced in this document, this section covers requirements that are specific to underground operations work.

### 6.1 PPE Requirements

Applies to: All contractors, as needed.

All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.

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<b>Contractor Safety Requirements</b>	Date:	04/01/05

## **6.2 Enclosed Space Assessment and Ventilation**

Applies to: All contractors, as needed.

1. The contractor shall test each space prior to removing manhole lids and entry.
2. Atmospheric testing must be continuous for the duration of the entry.
3. When performing lead or asbestos work or when indicated by atmospheric monitoring, engineering controls such as forced mechanical ventilation must be used when working in National Grid manholes during the entire performance of the work.

## **6.3 Enclosed Space Entry and Non-Entry Rescue**

Applies to: All contractors, as needed.

1. All manhole and sidewalk vault entry shall be conducted in accordance with National Grid enclosed space procedures.
2. All contractors who are qualified electrical workers will treat these spaces as “enclosed spaces” and follow non-entry rescue provisions.
3. Steel cable or wire rope for non-entry rescue is prohibited.

## **7.0 SUBSTATIONS**

Applies to: All contractors, as needed.

In addition to the other requirements referenced in this document, this section covers requirements that are specific to substations work.

### **7.1 PPE Requirements**

Applies to: All contractors, as needed.

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.
2. Contractors will wear an electrical flash PPE ensemble when switching disconnects or grounding in areas in indoor substations.

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Contractor Safety Requirements	Date:	04/01/05

## **7.2 Notification of Control Authority When Entering a Substation**

Applies to: All contractors, as needed.

1. When a contractor enters and exits a National Grid substation, the contractor will ensure that the System Control Center is notified.
2. Unescorted entry in substations can only be provided to contractors who provide assurance that their employees and subcontractors are electrically qualified as specified in 29 CFR 1910.269. Refer to Section 4.0 of this document.

## **7.3 Substation Work Area Identification (SWAI)**

Applies to: All contractors, as needed.

Contractors who will be working in substations shall follow the SWAI procedure. National Grid will provide a copy of this procedure if required by the project.

## **7.4 Herbicide Application**

Applies to: All contractors, as needed.

1. Substation vegetation spraying shall be conducted unescorted only by contractor employees who have been designated as a Qualified Electrical Worker.
2. The spray applicator will have ID cards issued by Security with background checks available from the contractor.
3. Substations management shall require a schedule of the spraying in their areas.
4. Once spraying begins, the contractor must contact local management on a daily basis to inform them of progress or changes to the schedule.
5. The contractor must post all stations with dated signs indicating when the station was sprayed. These signs should not inhibit access to the station.
6. The contractor shall take care to prevent that any stored materials and equipment do not get covered with "overspray". Overspray represents a substantial safety hazard and cannot be allowed.

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## **8.0 GAS OPERATIONS WORK**

Applies to: All contractors, as needed.

In addition to the other requirements referenced in this document, this section covers requirements that are specific to gas operations work.

All contractors shall be familiar with and comply with GOPB Section 700 (Worker Safety) and Section 401 (Live Gas Work). All contractors are required to have a copy of the GOPB on all job sites.

### **8.1 PPE Requirements**

Applies to: All contractors, as needed.

1. All contractors shall comply with the applicable PPE and WZTC requirements referenced in Section 4.0.
2. The contractor shall wear Class 2 rubber gloves for personal protection when digging or probing near (2 feet - 2 inches) known electrical conductors and when the location of energized conductors is unknown.

## **9.0 FORESTRY AND VEGETATION MANAGEMENT**

Applies to: All contractors, as needed.

In addition to the other requirements referenced in this document, this section covers requirements that are specific to vegetation management work.

### **9.1 PPE Requirements**

Applies to: All contractors, as needed.

1. For work along roads and other areas of vehicular traffic, contractors shall wear high visibility clothing or vests in addition to other PPE appropriate to the work.
2. Flame Retardant Clothing is not applicable for Forestry contractors. Forestry contractors must instead wear natural fiber clothing when working within 10 feet of energized equipment.
3. Forestry contractors must wear a properly adjusted full-body fall protection harness connected to an appropriate lanyard when working from an aerial lift. The lanyard must connect to an attachment anchored to either the boom or bucket mounting hardware. Attachment points anchored through only the fiberglass portion of the bucket are not acceptable.

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4. Forestry contractors will be required to wear chaps while using a chainsaw on the ground.

## **9.2 Equipment and Work Methods**

Applies to: All contractors, as needed.

1. Forestry contractors will be required to utilize fiberglass stick and stick saws for work around energized equipment and to test/document their integrity annually.
2. Forestry contractors will be required to perform and document dielectric testing of all aerial units annually.

## **9.3 Training**

Applies to: All contractors, as needed.

1. Forestry contractor management will be required to attend a quarterly executive safety council meeting hosted by National Grid USA. The contractor will ensure that all appropriate safety personnel for the National Grid USA territory are in attendance.
2. Forestry contractors shall implement and provide the required training and certification programs necessary to provide OSHA defined Qualified Line Clearance Tree Trimmers or Qualified Line Clearance Tree Trimmer Trainees.
3. For Lump Sum or Unit Price mileage trimming projects a single foreman may supervise up to four (4) bucket trucks on the same project. However, in that case, the minimum qualifications for the "lead" person on each of the other trucks shall be a Journeyman Tree Trimmer or equivalent (Qualified Line Clearance Tree Trimmer). At least one other employee on the truck shall be an OSHA defined, Qualified Line Clearance Tree Trimmer Trainee.
4. By April 1st of each year, the contractor shall provide a list of employees that could reasonably be expected to work on National Grid USA property. This listing shall include:
  - identify the current pay classification of each employee
  - the date of their progression to their current pay level,
  - the dates each employee completed each level of the contractor line clearance tree trimmers training program,

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<b>Contractor Safety Requirements</b>	Date:	04/01/05

- the dates each employee completed their required OSHA safety and other training, or retraining, including any annual refreshers,
- the date each employee last demonstrated their tree rescue and climbing proficiency where applicable
- the date each employee completed CPR and first aid training, and;
- identify each certified pesticide applicator, their certification number and category certified.

#### **9.4 Herbicide Applications**

Applies to: All contractors, as needed.

Contractor requirements for substation vegetation spraying are referenced under the Substations Work section of this document.

## OVERHEAD LINES

Line Worker Progression	Progression period	Required Training/Testing	Test Make-up
Apprentice to 3/C	6 months	Climbing School 5 days	Written test, 75% required to pass & completion of practical exercises
		Apprentice Line Worker School 30 days	2 written tests, 75% required to pass & completion of practical exercises
		Hoisting, Rigging, & Securement 4 days	Written test, 75% required to pass & completion of practical exercise
		CDL Class A 5 days	Written and practical test per state requirements
		Basic Electricity 5 days	Written test, 75% required to pass
		Line Worker 3/C School 10 days	Written test, 75% required to pass & completion of practical exercises
		Field Proficiency Checklist	Tasks assigned and completed in the field
Line Worker 3/C to 2/C	18 months	Line Worker 2/C School 10 days	Written test, 75% required to pass & completion of practical exercises
		Field Proficiency Checklist	Tasks assigned and completed in the field
Line Worker 2/C to 1/C	24 months	URD School 4 days	Written test, 75% required to pass
		Switching and Tagging 3 days	Written test, passing determined upon review of test results by supervisor
		Switching Operations 5 days	Successful completion of course
		Line Worker 1/C School 10 days	Written test, 75% required to pass & completion of practical exercises
		Field Proficiency Checklist	Tasks assigned and completed in the field
Line Worker 1/C to Crew Leader	(the senior qualified)	none	
Troubleshooter	2 yrs @ 1/C	Meter Operations	Successful completion of course
		UG Operations	Written test, 75% required to pass

Progression is required through shaded area.

## UNDERGROUND LINES

Cable Splicer Progression	Progression period	Required Training/Testing	Test Make-up
Apprentice Splicer to Splicer 3/C	15 months	Basic Underground Skills 10 days	Successful completion of course
		Hoisting, Rigging, & Securement 5 days	Written test, 75% required to pass plus practical exercise
		CDL Driver Class A 5 days	Written and practical test by state
		Basic Electricity 5 days	Written test, 75% required to pass
		Asbestos Worker 40 Hrs	Written/practical test per regulatory requirements
		Switching and Tagging Rules 3 days	Written test, passing determined upon review of test results by supervisor
		Splicer 3/C School 30 days (3 sessions @ 10 days each)	Written test, 75% required to pass & practical test*
		URD School 4 days	Written test, 75% required to pass
		Field Proficiency Checklist	Tasks assigned and completed in the field
Splicer 3/C to Splicer 2/C	15 months	Switching Operations 5 days	Successful completion of course
		Meter Operations 2 days	Successful completion of course
		Splicer 2/C School 20 days (2 sessions @ 10 days each)	Written test, 75% required to pass & practical test*
		Field Proficiency Checklist	Tasks assigned and completed in the field
Splicer 2/C to Splicer 1/C	12 months	Splicer 1/C School 10 days	Written test, 75% required to pass & practical test*
		Field Proficiency Checklist	Tasks assigned and completed in the field
Splicer 1/C to Lead Splicer	12 months	none	

Progression required through shaded area.

\*An employee will attend an additional session of 5 to 10 days to complete the practical test requirements.

## SUBSTATION OPERATION & MAINTENANCE

Substation Worker Progression	Progression period	Required Training/Testing	Test Make-up
Substation Worker Apprentice to 3/C	6 months	Basic Electricity 5 days	Written test, 75% required to pass
		CDL Driver Training 5 days	Written and practical test by state
		Switching and Tagging Rules 3 days	Written test
		Progression Test	Practical and Written Tests administered by field supervision
		Field Proficiency Checklist	Tasks assigned and completed in the field
Substation Worker 3/C to 2/C	18 months	Hoisting, Rigging, and Securement 3 days	Written test, 75% required to pass plus practical exercise
		Switching Operations 5 days	Successful completion of course
		Battery Maintenance 5 days	Written test, 75% required to pass
		Intro to Transformers 5 days	Written test, 75% required to pass
		Intro to Circuit Breakers 4 days	Written test, 75% required to pass
		Visual & Operational Inspections 3 days	Written test, 75% required to pass
		Intro to Voltage Regulators 3 days	Written test, 75% required to pass
		Intro to Test Equipment 5 days	Written test, 75% required to pass
		Asbestos Competent Worker 16 Hrs	Written/practical test per regulatory requirements
		Progression Test	Practical and Written Tests administered by field supervision
		Field Proficiency Checklist	Tasks assigned and completed in the field
Substation Worker 2/C to 1/C	24 months	Print Reading and Troubleshooting 5 days	Written test, 75% required to pass
		Power Factor Testing & Analysis 5 days	Written test, 75% required to pass
		Circuit Breaker Travel Analysis 5 days	Written test, 75% required to pass
		Progression Test	Practical and Written Tests administered by field supervision
		Field Proficiency Checklist	Tasks assigned and completed in the field
Substation Worker 1/C to Working Leader	18 months	Progression Test	Practical and Written Tests administered by field supervision

Progression required through shaded area

Record Request DTE-8

Request:

Each party is requested to outline what specific training requirements, if any, should be considered by the Department for internal and external employees and contractors who are likely to perform work on electric and gas distribution systems.

Response:

Mass. Electric recommends against including training requirements in the service quality plans, since training is an input-related measure. Service quality plans are most effective when the resulting performance measures are based on controllable outputs and relate to customers' service expectations. As the Company's response to Record Request DTE-7 indicates, Mass. Electric's training requirements are extensive.

Prepared by or under the supervision of: Richard L. Francazio

Record Request DTE-9

Request:

Mass. Electric is requested to provide copies of reports from scientific studies that explain how topography affects the inherent reliability levels of individual feeders.

Response:

The study authored by Roy Billington of the University of Saskatchewan, referenced by Mr. Bouford during the technical session on page 430 of the transcript, has not yet been published. Once it has been published, the Company will provide it to the Department. In its place, a list of other papers, with their individual abstracts, that are in the public domain is attached.

Prepared by or under the supervision of: James D. Bouford

**Power distribution system reliability planning using a fuzzy knowledge-based approach**

INS 00-25 6626869 B2000-08-8120J-002 (EEA) [NDN- 174-0662-6868-4](#)

**AUTHORS-** Lang, B. P.; Pahwa, A.

**JOURNAL NAME-** IEEE Transactions on Power Delivery

**ABBREVIATED JOURNAL TITLE-** IEEE Trans. Power Deliv. (USA)

**VOLUME** 15

**NUMBER** 1

**PUBLICATION DATE-** Jan. 2000

**PP** 279-84

18 REFERENCES

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**CORPORATE AUTHOR-** Dept. of Electr. & Comput. Eng., Kansas State Univ.,  
Manhattan, KS, USA

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**COPYRIGHT CLEARANCE CENTER CODE-** 0885-8977/2000/\$10.00

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**PUBLICATION COUNTRY-** USA

**ELECTRONIC JOURNALS DOCUMENT NUMBER-** S0885-8977(00)00555-0

**S I C I-** 0885-8977(200001)15:1L.279:PDSR;1-Z

**LANGUAGE-** English (DEF)

Electric power distribution system reliability is defined as the ability to deliver uninterrupted service to customers. Deregulation of the electric power industry has forced utilities to face new challenges and to evaluate the cost-benefit implications of providing an acceptable level of service. This paper presents a fuzzy knowledge-based approach for reliability planning purposes. This approach makes a direct assessment of the circuit configuration and hazards and assigns each section and feeder a relative risk index by expressing the configuration variables mathematically using fuzzy logic. Results obtained using the fuzzy model on actual utility feeder data are presented and the correlation between the fuzzy model results and actual feeder performance is obtained. Determination of the highest risk feeders and of the feeders which benefit the most from a given reliability improvement project are the major goals of the paper.

**Artificial neural-network based feeder reconfiguration for loss reduction in distribution systems**

EDB 93-22 93:140582 93001087732 [NDN- 108-0585-0133-0](#)

**AUTHORS-** Hoyong Kim; Yunseok Ko; Kyunghye Jung, (Korea Electrotechnology Research Inst., Changwon (Korea, Republic of). Dept. of Distribution System)

**JOURNAL NAME-** IEEE Transactions on Power Delivery (Institute of Electrical and Electronics Engineers) (United States)

**ABBREVIATED JOURNAL TITLE-** IEEE Trans. Power Deliv.

**VOLUME** 8

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**DOCUMENT TYPE-** Journal Article

**ISSN-** 0885-8977

**CODEN-** ITPDE5

**AUTHOR AFFILIATION-** Korea Electrotechnology Research Inst., Changwon (Korea, Republic of). Dept. of Distribution System

**LOCATION OF WORK-** KR

**SUBFILE CODE-** IMS

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**INCOMING TAPE SERIAL NUMBER-** IM9327%%590

**ANNOUNCEMENT IDENTIFICATION-** EDB-93:140582

**LANGUAGE-** English

Neural networks have the capability to map the complex and extremely non-linear relationship between the load levels of zone and system topologies, which is required for feeder reconfiguration in distribution systems. This study is intended to propose the strategies to reconfigure the feeder, by using artificial neural networks with mapping ability. Artificial neural networks determine the appropriate system topology that reduces the power loss according to the variation of load pattern. The control strategy can be easily obtained from the system topology which is provided by artificial neural networks. Artificial neural networks are in groups. The first group estimates the proper load level from the load data of each zone, and the second determines the appropriate system topology from the input load level. In addition, several programs with the training set builder are developed for the design, the training and the accuracy test of artificial neural networks. The authors also evaluate the performance of neural networks designed here, on the test distribution system. Neural networks are implemented in FORTRAN language, and trained on the personal computer COMPAQ 386.

**Comparative case studies for value-based distribution system reliability planning**

EIX 03-50 E2003507777518 [NDN- 267-0450-0601-7](#)

**AUTHORS-** Chang, Hong-Chan; Tsao, Teng-Fa

**ABBREVIATED JOURNAL TITLE-** Electr Power Syst Res

**VOLUME** 68

**NUMBER** 3

**PUBLICATION DATE-** 2004/March 2004

**PP** p 229-237

16 REFERENCES

**DOCUMENT TYPE-** JA Journal Article

**ISSN-** 0378-7796

**CODEN-** EPSRDN

**AUTHOR AFFILIATION-** Department of Electrical Engineering Natl. Taiwan Univ. of Sci./Technol., Taipei, Taiwan

**JOURNAL NAME-** Electric Power Systems Research

**LANGUAGE-** English

This paper will develop a set of reliability worth evaluation models to evaluate the load point reliability worth indices for five different distribution types. The distribution substations, primary distribution systems, and the interaction between them contribute to the load point reliability worth indices. The reliability worth of the distribution systems are evaluated in terms of customer interruption costs, by using the sector customer damage function (SCDF). The most suitable system design is based on comparisons of the total system costs of the candidates under consideration. Four case studies are thoroughly examined in this paper. Also, the impact on customer interruption costs associated with customer type, substation configuration, and feeder configuration are investigated. \$CPY 2003 Elsevier B.V. All rights reserved. 16 Refs.

**Reconfiguration for loss reduction in distribution networks**

**MONOGRAPH TITLE- IFAC Symposia Series**

EIX 93-29 EIX93290096680 [NDN- 017-0188-4110-0](#)

**AUTHORS-** Roldan, C.; Gonzalez, N.; Alvarez, C.

IFAC Symposia Series n 9 1992. Publ by Pergamon Press Inc, Tarrytown, NY, USA. p 281-286

**PUBLICATION DATE-** 1992

**DOCUMENT TYPE-** CA, Conference Artic

**ISSN-** 0962-9505

**ISBN-** 0-08-041709-4

**CODEN-** ISYSEK

**AUTHOR AFFILIATION-** Universidad Politecnica de Valencia, Valencia, Spain

**CONFERENCE DATE-** 19920309-19920311

**CONFERENCE TITLE-** Proceedings of the IFAC Symposium on Control of Power Plants and Power Systems

**CONFERENCE LOCATION-** Munich, Ger

**CONFERENCE CODE NUMBER-** 18506

**LANGUAGE-** English

The Automation of the Distribution level ( Distribution Automation, DA) is offering new possibilities that allow the operation of the distribution system in a more efficient and reliable way. One of these possibilities is the optimum network configuration in order to achieve both minimum resistive losses in the primary feeders and enhanced reliability for the supplied loads. The problem approached in this paper is that of network reconfiguration for loss reduction. The method proposed in the paper is based on an AC Power Flow performed over the distribution network completely meshed (with all the switches closed) and a fast algorithm has been developed for that purpose, using the compensation theorem and taking advantage of the similarities between radial and weakly meshed networks. The effect of opening every switch in the system is then evaluated and a ranked list is generated. A previous topological process allows some additional reduction in the computing time used for these loss increments evaluation. The suitability of the proposed method is demonstrated in the paper both for operation and planning purposes. (Author abstract) 11 Refs.

**Distribution network reconfiguration with reliability constraints**

INS 05-23 8456710 B2005-07-8120J-061 (EEA) [NDN- 259-0845-6709-0](#)

**AUTHORS-** Coelho, A.; Rodrigues, A. B.; Da Silva, M. G.

**ABBREVIATED JOURNAL TITLE-** 2004 International Conference on Power System Technology - POWERCON (IEEE Cat. No.04EX902)

**PART NUMBER-** Vol.2

**PUBLICATION DATE-** 2004

**PP** 1600-6 Vol.2

2 vol. (xx+2002) PAGES

10 REFERENCES

**DOCUMENT TYPE-** Conference paper

**ISBN-** 0 7803 8610 8

**CORPORATE AUTHOR-** Dept. of Electr. Eng., Fed. Univ. of Maranhao, Brazil

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**PUBLICATION PLACE-** Piscataway, NJ, USA

**PUBLICATION COUNTRY-** USA

**CONFERENCE DATE-** 21-24 Nov. 2004

**CONFERENCE TITLE-** 2004 International Conference on Power System Technology - POWERCON

**CONFERENCE LOCATION-** Singapore

**LANGUAGE-** English (DEF)

Electric distribution networks reconfiguration is carried out by the opening/closing of switching devices while keeping the feeder's radial topology. Traditionally, the reconfiguration of distribution networks has been implemented aiming to: minimize electric losses in the conductors, to enhance voltage profiles and balance the feeder's loads. However, the proposed methodologies for achieving these objectives do not include the reconfiguration impacts on the system reliability indices. The main aim of this paper is to present a methodology for reconfiguring a distribution network with the objective of minimizing the electric losses taking into account constraints associated with: overloads, voltage drops and violation of the targets for reliability indices. The proposed methodology for solving this problem is based on the parallel simulated annealing algorithm. This methodology allows the generation of candidate solutions without violating topological constraints. The proposed model has been validated and tested in standard distribution systems.

**Distribution reliability analysis program**

INS 05-17 8394649 B2005-06-8120J-037 (EEA); C2005-06-7410B-137

(CCA) [NDN- 259-0839-4648-5](#)

**AUTHORS-** Vicentini, O. H. S.; de Oliveira, H. R. P. M.; Oling, R.; Martinez, M. L. B.; Saran, M. A.; Bachega, R. J.; Violin, A.; Lefort, C.

**ABBREVIATED JOURNAL TITLE-** 2004 IEEE/PES Transmission and Distribution Conference and Exposition: Latin America (IEEE Cat. No. 04EX956)

**PUBLICATION DATE-** 2004

**PP** 102-6

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4 REFERENCES

**DOCUMENT TYPE-** Conference paper

**ISBN-** 0 7803 8775 9

**CORPORATE AUTHOR-** Distribuidora Gaucha de Energia S/A, AES Sul, Sao Leopoldo, Brazil

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**CONFERENCE LOCATION-** Sao Paulo, Brazil

**LANGUAGE-** English (DEF)

The objective of this paper is to present a computer program developed for Windows to compute reliability indices for different customers and sets of customers supplied by the same distribution feeder. This program deals with information obtained directly from utility databases to create equivalent network modeling and carry out contingency analytical simulations. The system's average failure rates must be informed by the user, based on historical utility data, manufacturer test data or typical values. The program enables one to compute penalties and annual costs of energy interruptions and compare the obtained indices with the reliability index targets set by the national regulatory agency (ANEEL) for the different sets of customers and distribution feeders under analysis. The program allows to analyze the influence the variation of the system rates and also modifications of the topology of the network and, thus, to carry out a sensitive study to verify the effect of some different protection equipment and modifications in the topology of the systems, justifying investments that can improve the reliability, the power quality, and reduce costs of energy interruption and other related costs.

**Distribution network reconfiguration - a case study**

INS 04-27 8024158 B2004-08-8120J-042 (EEA) [NDN- 259-0802-4157-5](#)

**AUTHORS-** Sriyatmo, E.; Harsono, B.; Dahono, P. A.; Riyadi, A.; Hariyanto, N.

**ABBREVIATED JOURNAL TITLE-** IPEC2003 - 6th International Power Engineering Conference Proceedings

**PART NUMBER-** Vol.2

**PUBLICATION DATE-** 2003

**PP** 869-73 Vol.2

xxvii+A5 PAGES

2 REFERENCES

**DOCUMENT TYPE-** Conference paper

**ISBN-** 981 04 8790 8

**CORPORATE AUTHOR-** Jakarta Distribution Unit, PT PLN, Persero, Indonesia

**COPYRIGHT OF BIBLIOGRAPHIC-** Copyright 2004, IEE

**PUBLISHER-** Nanyang Technological University

**PUBLICATION PLACE-** Singapore

**PUBLICATION COUNTRY-** Singapore

**CONFERENCE DATE-** 27-29 Nov. 2003

**CONFERENCE TITLE-** IPEC2003 - 6th International Power Engineering Conference Proceedings

**CONFERENCE LOCATION-** Singapore

**LANGUAGE-** English (DEF)

This paper presents a case study on how to improve the performance of Jakarta power distribution system of PT. PLN, Indonesia. At first, the reliability of the existing power distribution system is evaluated. Reliability of each component is reported. It is shown that the existing network topology should be reconfigured if high reliability is desired. Various possible topologies to improve the existing system are then evaluated. The most suitable topology is the one that gives a compromise among reliability , cost, and flexibility.

**Assessing the reliability of distribution systems**

INS 01-04 6824061 B2001-03-8120J-001 (EEA); C2001-03-7410B-019 (CCA) [NDN- 174-0682-4060-8](#)

**AUTHORS-** Brown, R. E.; Hanson, A. P.; Willis, H. L.; Luedtke, F. A.; Born, M. F.

**JOURNAL NAME-** IEEE Computer Applications in Power

**ABBREVIATED JOURNAL TITLE-** IEEE Comput. Appl. Power (USA)

**VOLUME** 14

**NUMBER** 1

**PUBLICATION DATE-** Jan. 2001

**PP** 44-9

7 REFERENCES

**DOCUMENT TYPE-** Journal paper

**ISSN-** 0895-0156

**CODEN-** ICAPEH

**CORPORATE AUTHOR-** ABB, Raleigh, NC, USA

**COPYRIGHT OF BIBLIOGRAPHIC-** Copyright 2001, IEE

**COPYRIGHT CLEARANCE CENTER CODE-** 0895-0156/2001/\$10.00

**PUBLISHER-** IEEE

**PUBLICATION COUNTRY-** USA

**S I C I-** 0895-0156(200101)14:1L.44:ARDS;1-P

**LANGUAGE-** English (DEF)

Since a typical distribution system accounts for 40% of the cost to deliver power and 80% of customer reliability problems, distribution system design and operation is critical for financial success and customer satisfaction. To address this situation, Commonwealth Edison is integrating reliability assessment techniques into distribution planning and engineering. Just as equipment loading and voltage regulation are treated with analytical rigor with power flow models, interruptions and outages can be treated with analytical rigor with reliability models. This is made possible through the use of predictive reliability assessment tools that are able to predict customer reliability characteristics based on system topology and component reliability data. Reliability software predicts expected interruption frequencies and duration in a manner analogous to current and voltage evaluations in traditional power flow models. This article describes the distribution system's reliability assessment model jointly developed by Commonwealth Edison and ABB. This effort modeled, calibrated, and assessed the reliability of more than 3300 feeders. After completing the model, an intelligent system was used to automatically identify potential reliability problems and recommend reliability improvement projects based on expected benefits and costs.

**Multi-objective feeder reconfiguration by distribution management system**

INS 96-23 5289320 B9607-8120J-017 (EEA); C9607-3340H-161 (CCA) [NDN- 083-0528-9319-1](#)

**AUTHORS-** Roytelman, I.; Melnik, V.; Lee, S. S. H.; Lugtu, R. L.

**JOURNAL NAME-** IEEE Transactions on Power Systems

**ABBREVIATED JOURNAL TITLE-** IEEE Trans. Power Syst. (USA)

**VOLUME** 11

**NUMBER** 2

**PUBLICATION DATE-** May 1996

**PP** 661-7

15 REFERENCES

**DOCUMENT TYPE-** Journal paper

**ISSN-** 0885-8950

**CODEN-** ITPSEG

**CORPORATE AUTHOR-** Siemens Energy & Autom. Inc., Brooklyn Park, MN, USA

**COPYRIGHT OF BIBLIOGRAPHIC-** Copyright 1996, IEE

**COPYRIGHT CLEARANCE CENTER CODE-** 0885-8950/96/\$05.00

**PUBLISHER-** IEEE

**PUBLICATION COUNTRY-** USA

**S I C I-** 0885-8950(199605)11:2L.661:MOFR;1-#

**LANGUAGE-** English (DEF)

Feeder reconfiguration for use by distribution management systems is discussed in this paper. Multiple objectives are proposed to reflect realistic operating environments while achieving all benefits from feeder reconfiguration. The multiple objectives considered are minimization of power losses, load balancing among supply transformers, minimization of the worst voltage drop, minimization of service interruption frequency, and balanced service of important customers for enhanced service reliability. The objective function containing five different objectives are optimized subject to capacity and protection device constraints. The overall solution approach is a two-stage process. In the first stage, a suboptimal solution is found by analyzing the mesh distribution system in which all open switches are simulated to be closed. Applying special power flow analyses to this mesh network, a radial distribution system is determined as an intermediate solution. In the second stage, this solution is continuously improved by the branch exchange scheme. Special topology models are also developed to accelerate the search procedure. Use of the algorithm is illustrated by numerical examples.

**Multi-objective feeder reconfiguration by distribution management system  
MONOGRAPH TITLE- 1995 IEEE power industry computer application**

**conference: Proceedings**

EDB 96-20 96:142591 96001664824 [NDN- 108-0634-2914-7](#)

**AUTHORS-** Roytelman, I.; Melnik, V.; Lee, S. S. H.; Lugtu, R. L., (Siemens Energy and Automation, Inc., Brooklyn Park, MN (United States))

**PUBLICATION DATE-** 1995

**PP** 517-522

588 PAGES

**DOCUMENT TYPE-** Book Analytic

**AUTHOR AFFILIATION-** Siemens Energy and Automation, Inc., Brooklyn Park, MN (United States)

**LOCATION OF WORK-** US

**LITERARY INDICATOR-** Conference

**REPORT NUMBER-** CONF-950525--

**SUBFILE CODE-** IMS

**PUBLISHER-** Inst. of Electrical and Electronics Engineers

**PUBLICATION PLACE-** Piscataway, NJ (United States)

**PUBLICATION COUNTRY-** US

**CONFERENCE DATE-** 7-12 May 1995

**CONFERENCE TITLE-** IEEE power industry computer applications conference

**CONFERENCE LOCATION-** Salt Lake City, UT (United States)

**ANNOUNCEMENT CODE-** EDB; ETD

**INCOMING TAPE SERIAL NUMBER-** IM9640%%166

**ANNOUNCEMENT IDENTIFICATION-** EDB-96:142591

**LANGUAGE-** English

Feeder configuration for use by distribution management systems is discussed in this paper. Multiple objectives are proposed to reflect realistic operating environments while achieving all benefits from feeder reconfiguration. The multiple objectives considered are minimization of power losses, load balancing among supply transformers, minimization of the worst voltage drop, minimization of service interruption frequency, and balanced service of important customers for enhanced service reliability. The objective function containing five different objectives are optimized subject to capacity and protection device constraints. The overall solution approach is a two-stage process. In the first stage, a suboptimal solution is found by analyzing the mesh distribution system in which all open switches are simulated to be closed. Applying special power flow analyses to this mesh network, a radial distribution system is determined as an intermediate solution. In the second stage, this solution is continuously improved by the branch exchange scheme. Special topology models are also developed to accelerate the search procedure. Use of the algorithm is illustrated by numerical examples.

**Optimal allocation of tie points in radial distribution systems using a genetic algorithm**

INS 04-33 8068570 B2004-10-8120J-007 (EEA) [NDN- 259-0806-8569-8](#)

**AUTHORS-** Haghifam, M.-R.

**JOURNAL NAME-** European Transactions on Electrical Power

**ABBREVIATED JOURNAL TITLE-** Eur. Trans. Electr. Power (Germany)

**VOLUME** 14

**NUMBER** 2

**PUBLICATION DATE-** March-April 2004

**PP** 85-96

17 REFERENCES

**DOCUMENT TYPE-** Journal paper

**ISSN-** 1430-144X

**CODEN-** ETEPFB

**CORPORATE AUTHOR-** Dept. of Electr. Eng., Tarbiat Modarres Univ., Tehran, Iran

**COPYRIGHT OF BIBLIOGRAPHIC-** Copyright 2004, IEE

**PUBLISHER-** VDE-Verlag

**PUBLICATION COUNTRY-** Germany

**S I C I-** 1430-144X(200403/04)14:2L.85:OAPR;1-9

**LANGUAGE-** English (DEF)

For reliability enhancement of radial distribution systems, normally open tie switches are located in feeders. Using tie switches and sectionalizers, the configuration of feeders can be changed in fault conditions for supplying customers from other routes. This is called load restoration in radial distribution systems. In this paper, it is shown that reliability and success of load restoration have a connection with location and number of tie switches. Also, a novel approach for optimal determination of the number and location of tie switches using a genetic algorithm is proposed. In the optimization procedure, load importance using fuzzy membership functions, cost of energy not supplied and cost of tie switches are considered. The effectiveness of the proposed method is shown by simulation results in a radial distribution network.

**Distribution feeder reliability studies**

INS 99-16 6222999 B1999-05-8120J-040 (EEA) [NDN- 174-0622-2998-7](#)

**AUTHORS-** Kersting, W. H.; Phillips, W. H.; Doyle, R. C.

**JOURNAL NAME-** IEEE Transactions on Industry Applications

**ABBREVIATED JOURNAL TITLE-** IEEE Trans. Ind. Appl. (USA)

**VOLUME** 35

**NUMBER** 2

**PUBLICATION DATE-** March-April 1999

**PP** 319-23

**2 REFERENCES**

**DOCUMENT TYPE-** Journal paper

**ISSN-** 0093-9994

**CODEN-** ITIACR

**CORPORATE AUTHOR-** Dept. of Electr. & Comput. Eng., New Mexico State Univ.,  
Las Cruces, NM, USA

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**COPYRIGHT CLEARANCE CENTER CODE-** 0093-9994/99/\$10.00

**PUBLISHER-** IEEE

**PUBLICATION COUNTRY-** USA

**ELECTRONIC JOURNALS DOCUMENT NUMBER-** S0093-9994(99)02241-0

**S I C I-** 0093-9994(199903/04)35:2L.319:DFRS;1-X

**LANGUAGE-** English (DEF)

As the power industry moves into a new competitive era, the reliability of radial distribution feeders becomes a primary issue in comparing the "new" versus the "old" way of serving customers. In order to make the comparison, a distribution engineer needs to have the analysis tools to perform the necessary reliability studies. For the purposes of this paper, the reliability studies will be limited to the calculation of the annual "outage rate" and associated "restoration time" for a typical customer on a radial distribution feeder. This paper develops the background and theory for computing these reliability indices. The method can be applied to demonstrate how different devices and/or feeder configurations affect the average customer on a specific feeder.

**Reliability analysis for improving configurations of power systems**

INS 96-02 5159993 B9602-8110-024 (EEA) [NDN- 083-0515-9993-0](#)

**AUTHORS-** Wang Jinzhi; Jiang Ronghan; Fu Jianguo

**JOURNAL NAME-** Power System Technology

**ABBREVIATED JOURNAL TITLE-** Power Syst. Technol. (China)

**VOLUME** 19

**NUMBER** 11

**PUBLICATION DATE-** Nov. 1995

**PP** 39-43, 48

6 REFERENCES

**DOCUMENT TYPE-** Journal paper

**ISSN-** 1000-3673

**CODEN-** DIJIES

**CORPORATE AUTHOR-** Hunan Univ., Changsha, China

**COPYRIGHT OF BIBLIOGRAPHIC-** Copyright 1996, IEE

**PUBLISHER-** Electr. Power Res. Inst

**PUBLICATION COUNTRY-** China

**S I C I-** 1000-3673(199511)19:11L.39:RAIC;1-U

**LANGUAGE-** Chinese

Based on a previous paper by the authors, a typical feeder in an actual urban electric power distribution system is taken as the object of the study. According to the existing configuration, the six improved configurations worked out. Using the reliability data and indices, the reliability of these configurations is analyzed. Study results present some practical suggestions for improving feeder configurations

**Distribution protection and restoration systems: design verification by reliability indices. IEEE Power Systems Relaying Committee report**

INS 74-01 673003 B74032749 (EEA) [NDN- 082-0067-3003-8](#)

NO-AUTHOR

**JOURNAL NAME-** IEEE Transactions on Power Apparatus and Systems

**ABBREVIATED JOURNAL TITLE-** IEEE Trans. Power Appar. Syst. (USA)

**VOLUME** PAS-93

**NUMBER** 2

**PUBLICATION DATE-** March-April 1974

**PP** 564-70

9 REFERENCES

**DOCUMENT TYPE-** Journal paper

**ISSN-** 0018-9510

**CODEN-** IEPSA9

**PUBLICATION COUNTRY-** USA

**LANGUAGE-** English (DEF)

In designing a protective scheme and circuit configuration for distribution circuits, it is desirable to quantitatively compare the performance of distribution circuits for various alternatives. The indices used for such comparison must be sensitive to the number, type, and location of protective devices, to circuit exposure, and to restoration practices. Four reliability indices are defined in this paper. An analysis technique is presented which evaluates the four reliability indices for any given distribution feeder in a logical and consistent manner. A digital computer program employing the above analysis techniques is applied to a sample problem which demonstrates the effectiveness of various protective devices and operating practices in terms of the reliability indices.

Record Request DTE-10

Request:

Each electric company is requested to provide the distribution system losses at the time of the entire system peak at various voltage class levels, to the lowest voltage class level possible.

Response:

ISO-NE apparently no longer runs load flows to determine losses at the various delivery voltage levels. Mass Electric ran a special load flow to determine these losses at the noted system load level.

Assumed ISO-NE, NEPOOL Load	26,446 MW	
Assumed Mass. Electric Load	4,843.5 MW	
Loss:		
345 kV	18.113 MW	0.37 %
230 kV	6.274 MW	0.13 %
115 kV	76.884 MW	1.59 %
69 kV	18.424 MW	0.38 %
46 kV	1.977 MW	0.04 %
34.5 kV	2.336 MW	0.05 %
23 kV	20.071 MW	0.41 %
Total:	144.078 MW	2.97 %

Prepared by or under the supervision of: James D. Bouford